Original article

Optimal coronary artery bypass graft timing in high-risk acute myocardial infarction with ST elevation

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Abstract: Background — Despite advances in surgical techniques, still tendency for waiting up to 6 weeks after myocardial infarction with ST segment elevation (STEMI). We aimed to evaluate optimal timing for coronary artery bypass graft (CABG) in stable patients with STEMI. Material and Methods — Prospective, randomised study consisted of 30 patients with STEMI (age 57-78 years, 22 male) underwent on-pump CABG. According to the timing of CABG they were stratified as urgent (0-2 day) and late group (3 day and after). Transthoracic echocardiography and selective coronarography were done before surgery. Patients with ejection fraction (EF) >50%, left main stenosis and/or multivessel coronary disease were included in the study. We excluded patients with mechanical complications, reduced EF, cerebrovascular insult (CVI), renal failure or respiratory insufficiency. Results — The primary endpoint for 30 days were adverse cardiac events (death, recurrent angina, prolonged mechanical ventilation/IABP insertion CVI, acute kidney injury, major bleeding). Eight (26.6%) patients underwent urgent CABG in first 48 h. due to haemodynamic instability/ongoing ischemia Three (37.5%) of them died and 6 (75%) had prolonged mechanical ventilation support and/or IABP. Twenty two (73.3%) patients in late group were operated after period of stabilization (10–14 day). They were discharged on 6-7 postoperative day. Conclusion — Early surgery may be risky, but its delay also carries the risk of devastating complications. Stable patients operated on 10-14 day had similar outcomes as elective cases. Keywords: acute myocardial infarction with ST elevation, coronary artery bypass graft, intraaortic balloon pump, mechanical ventilation


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Introduction

The myocardial infarction (MI) is the leading cause for death in industrial as well as in the developing countries. Contemporary non-surgical procedures, fibrinolytic therapy and primary percutaneous coronary intervention (PCI) in patients with acute myocardial infarction with ST segment elevation (STEMI), significantly reduce morbidity and mortality. Early surgical revascularization, coronary artery bypass graft (CABG), is reserved for left main and/or 3 vessel coronary disease, ongoing ischemia after successful or not PCI, coronary anatomy not adequate for PCI and mechanical complications of STEMI [1].

There was a trend in the early 70-ties for an urgent CABG in the patients with acute MI. But, retrospective studies showed an enormous mortality rate in comparison to elective surgery. The end of the 80-ties hypothesized the risk of hemorrhagic transformation from reperfusion and infarct extension, altered recovery and scar formation. Soon after, was introduced the practice to operate patients after 6 weeks of MI with Q wave. But after all these years, the optimal timing of CABG in hemodynamically stable STEMI patients remains controversial. There is a lack of prospective randomized study which compares the results of early versus late CABG in patients after MI [2].

Patients with hemodynamically stable STEMI, with indication for CABG, have a certain risk of serious complications, early and late, such as malignant arrhythmias, cardiogenic shock, pericarditis, embolism, mechanical complications (early), congestive heart failure, post MI syndrome or left ventricular aneurysm (late) [3].

Thus, if waiting too long for surgery carry the risk of complications, we hypothesize that shorten period of 4-6 weeks could be considered as an adequate. We aimed to evaluate optimal timing for bypass surgery in patients with STEMI.

Material and Methods

The study was prospective, randomised, open-labeled, consisted of 30 patients with STEMI. They presented with severe precordial pain, time onset more than 3 hours, and high myocardial enzyme activity (high sensitive cardiac troponin T, creatine kinase-MB). All patients underwent transthoracic echocardiography and selective coronarography. Inclusion criteria...
were preserved systolic function (ejection fraction >50%), left main stenosis and/or multivessel coronary disease. Mechanical complications, reduced ejection fraction (EF) <50%, stroke, renal failure or respiratory insufficiency, were exclusion criteria.

The patients were prepared according to preoperative protocol and were stratified by the timing of CABG to urgent (0-2 day) and late group (day 3 and after).

On-pump CABG was performed under general anesthesia with endotracheal intubation, with standard surgical approach: median sternotomy. Left internal mammary artery (LIMA) was used to bypass the left anterior descending (LAD), right internal mammary artery (RIMA) to graft the left circumflex (LCx)/right coronary artery (RCA) and reversed saphenous vein grafts (SVGs) in case of multivessel coronary artery disease (CAD). Transesophageal echocardiography (TEE) was used during the surgery.

The primary endpoint at day 30 were death, chest pain, the dynamic of cardiac enzymes (cardiac troponin T, creatine kinase-MB), need of inotropic support, prolongs mechanical respiratory support, intra-aortic balloon pump (IABP) insertion, major bleeding, length of stay in intensive care unit (ICU) and overall hospitalization period as well as major bleeding, reinfarction, stroke and acute kidney Statistics

The statistical analyses were performed by using the commercial statistical package, Statistica for Windows, Version 6.0. Continuous parameters were expressed as mean with standard deviation (M±SD). The Mann–Whitney U-test was used to test the distribution for two independent variables and Wilcoxon Matched Pairs Test for two dependent samples. A p<0.05 was considered to indicate significance.

Results

During the period of one year, 30 patients underwent on-pump CABG within 2 weeks of acute STEMI. They were at the age between 57 and 78 years, and 22 (73.3%) of them were male gender. Four patients (13.3%) got 2 bypasses, 25 (83.3%) got 3 bypasses and 1 patient (3.3%) got 4 bypass grafts. Demographic and clinical characteristics are given in Table 1.

In the urgent CABG group, 8 (26.6%) patients with persistent angina were operated in the first 48 h. One (12.5%) of them, due to hemodynamic instability (oxygen saturation (SaO2) <98%), systolic blood pressure (SBP) <90 mmHg, mean arterial pressure (MAP) <60 mmHg underwent CABG during the first night. The other 7 patients (87.5%) underwent open heart surgery on second day of admission.

Of the 8 patients operated in the first 48 hours, 3 died (37.5%) in the first and third day after the operation. One of them (female gender) was at the age of 78, with hemodynamic instability and cardiac arrest. The second, was 67 years old male, presented with hemodynamic instability first day after the CABG due to reinfarction, and acute abdomen second day after the surgery. The reason for acute abdomen was stress ulcer. He was underwent laparotomy to suture the ulcer and he died immediately after surgery.

The third patient was 71 year old female. First day after the surgery she become hemodynamically unstable (low blood pressure, low ejection fraction, high central venous pressure), and insertion of IABP was done. She died third day after surgery, due to low cardiac output.

Two of the other 5 patients in urgent group had prolonged ICU stay to 10 and 15 days due to prolonged stay on the respiratory machine. The tracheotomies were performed and they were extubated after 1-2 weeks. The length of hospitalization was prolonged up to 20-27 days. No major complications were noted.

In the late CABG group, 22 (73.3%) patients were operated between 10 and 14 days after the onset of MI, stabilization and decrease in cardiac enzymes. There was no mortality or major intraoperative event. The patients were extubated without inotropic support. They left the hospital in good local and general condition, with normal laboratory findings, chest X rays and echocardiography, between 6 and 7 days after the surgery. Adverse cardiac events are shown in the Figure 1.

Regarding the enzyme activity, it was very high in all patients. The value of high sensitive cTnT reaching a peak of 20 ng/ml at the third day after the CABG, was noted stabilization of their activity. In the late CABG group, there was continuous high level the myocardial biomarkers. In the late CABG group, we noted stabilization of their activity.

The level of cardiac biomarkers at 6 hours after the onset of STEMI

Table 1. Demographic and clinical characteristics of the study patients

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Urgent CABG group (n=8)</th>
<th>Late CABG group (n=22)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, years, M±SD</td>
<td>71±4.5</td>
<td>71±4.2</td>
<td>NS</td>
</tr>
<tr>
<td>Male gender, no. (%)</td>
<td>6 (75%)</td>
<td>16 (73%)</td>
<td>NS</td>
</tr>
<tr>
<td>Hyperlipidemia, no. (%)</td>
<td>7 (87.5%)</td>
<td>13 (59%)</td>
<td>NS</td>
</tr>
<tr>
<td>Hypertension, no. (%)</td>
<td>6 (75%)</td>
<td>13 (63.6%)</td>
<td>NS</td>
</tr>
<tr>
<td>Diabetes, no. (%)</td>
<td>5 (62.5%)</td>
<td>13 (59%)</td>
<td>NS</td>
</tr>
<tr>
<td>Smoke, no. (%)</td>
<td>3 (25%)</td>
<td>8 (36.3%)</td>
<td>NS</td>
</tr>
</tbody>
</table>

Wilcoxon Matched Pairs Test did not shown statistically significant difference between groups. That means that both groups were homogeneous in terms of demographic and clinical parameters.

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Regarding the enzyme activity, it was very high in all patients. The value of high sensitive cTnT reaching a peak of 20 ng/ml at 6 hours after the onset of MI. The level of creatinine kinase-MB was also high (1,200 IU/L). In the urgent CABG group, there was continuous high level the myocardial biomarkers. In the late CABG group, we noted stabilization of their activity.

The level of cardiac biomarkers at 6 hours after the onset of STEMI is shown in Table 2.

The difference between the maximum activity of cardiac troponin T tested with Mann-Whitney U test showed statistical significance between two groups (U=145, p=0.007), but the
These results arise the question how long we may postpone the surgery, knowing that poor perfused myocardium is at risk of remodeling and new MI?

2014 ESC/EACTS Guidelines on myocardial revascularization state that in patients with STEMI suggests that in patients with reduced left ventricular systolic function CABG should be performed within 6 weeks, to allow myocardial recovery to occur. The data suggest poor quality of life in patients waiting long time for surgery, and in addition, higher costs for hospitalization. Also, other factors that influence early mortality are unstable angina, previous surgery (CABG), preoperative hypertension, non-elective surgery, previous cardiac arrest and female gender. Zaroff et al. in his study [9] with defined model of risk prediction stated that the mortality in patients with STEMI operated urgently is still higher than in elective (5.5%). Fifty-five percent of the patients have mortality between 4-13%, compared with elective, with 1 to 3% mortality rate. Despite female gender, the most important risk factor is age (75 years) and anamnesis of previous MI.

The most important process in these patients is LV remodeling after MI. It is a result of changed ventricular geometry and function because of MI. It is a compensatory mechanism aimed to increase the stroke volume in conditions where the ejection fraction is reduced. This leads to left ventricle dilatation and heart failure, a state that directly depends on the infarct size and the left ventricular wall stress. Factors, such as thrombolysis, angiotensin-converting-enzyme (ACE) inhibitors, angioplasty and CABG, may influence the remodeling. Theoretically, these patients have great benefit from the early revascularization while there is not irreversible necrosis and left ventricular dysfunction.

From the other side, the time of transformation from hibernation to irreversible dysfunction is not known. We would say that there is no way to predict the transformation and to operate in the moment when it is still not late. Delaying the surgery would be helpful to estimate the optimal timing for operation from one side, but we have to estimate the safety of waiting as well. There is data that conclude severe preoperative and postoperative complications while waiting longer, such as mortality. But also, the incidence of perioperative MI, permanent cerebrovascular events and atrial fibrillation are most frequent between the patients that are surgically revascularized right after the MI [10].

The same authors refer to quality of life after the revascularization in patients operated within 3 months and after 3 months of MI. The last, have significant reduction in physical activity, vitality, social function and the health in general. Also, the expenses for the hospitalization are greater.

Conclusion
We may conclude that patients with STEMI with clear indication for surgery should not wait too long, but if there is a possibility to wait at least 10 days after MI, and the CABG is in the first 2 weeks, the result could be the same as in elective patients.

Conflict of interest
The authors declared that they have no conflict of interest.

References


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