

A Single Center Experience with Off-pump Surgical Revascularization in Patients with Multi-vessel Coronary Artery Disease

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Abstract

Objectives: Surgical revascularization in patients with multi-vessel coronary artery disease still raises many questions.

The aim of the study was retrospective analysis of the single center immediate and mid-term results of off-pump Coronary artery bypass grafting (CABG) in patients with multivessel coronary artery disease.

Materials and Methods: This retrospective study includes 564 patients with IHD operated in the department of cardiac surgery in the Republican Research Center of Emergency Medicine in 2013-2017. Four hundred and seventy-three patients (84%) were male and 91(16%) were female, the average age was 56.2 ± 0.9 years.

Results: In the early postoperative period, 18 patients died, hospital mortality was 3.19%. Among the causes of mortality, there were perioperative myocardial infarction—eight (1.4%) and acute heart failure—eight (1.4%). In two cases (0.35%), the cause of death was septic complications. In a single-factor analysis, we observed that an unstable state on admission and emergent conversion to on-pump

can be considered reliable risk factors for the development of the lethal outcome in the early postoperative period. During the follow-up period (2-40 months on average 24.1 ± 0.34), 9 (2.4%) patients died, and the main causes of death were acute heart failure due to myocardial infarction in four (1.1%) and gastrointestinal bleeding in three (0.8%) patients. Freedom from the combined endpoint of cardiac death and myocardial infarction was 97.1% at 40 months; freedom from recurrent angina was 90.4% and freedom from repeated revascularization was 99.1%.

Conclusion: Patients with multivessel coronary disease and unstable angina in most cases can undergo off-pump CABG with favorable early results. Hemodynamical problems can force surgeon to turn on-pump. Emergent on pump conversion following hemodynamical instability can be a significant factor for mortality. In our series, CABG showed favorable immediate and mid-term results.

Keywords: Coronary artery bypass grafting (CABG), the treatment of coronary heart disease (CHD), ischemic heart disease (IHD); CABG with the use of artificial circulation (on-pump), and CABG on the beating heart (off-pump)



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Introduction

Coronary artery bypass grafting (CABG) occupies a special place in the treatment of ischemic heart disease (IHD). Its effectiveness in eliminating the symptoms of angina pectoris and increasing the life expectancy in some patient groups is currently undeniable. There are two methods of surgical revascularization of the cardiovascular system: a standard procedure of CABG with the use of cardiopulmonary bypass (on-pump), and CABG on beating heart (off-pump)^(1,2). Since the late 1990, beating heart CABG has become increasingly popular, as a result of introduction in clinical practice of devices that stabilize the heart for the application of anastomosis⁽³⁾. In the literature and modern periodical publications, we can note an active discussion about how and which method is preferred. A number of authors indicate a low efficiency of off-pump CABG associated with the risk of incomplete revascularization, and as a consequence of perioperative myocardial infarction and late graft failure^(4,5). Other authors emphasize the absence of statistically significant differences in the mortality rate, postoperative complications, infarction and stroke in the postoperative period, as well as other advantages and disadvantages when comparing both methods, emphasizes the same duration of functioning of shunts in the long-term follow-up period. Other researchers pay attention to the efficacy and safety of the method on the beating heart, both in patients with low and high risk⁽⁶⁾. In particular, according to the latest publications, off pump myocardial revascularization is accompanied by a short period of stay in the intensive care unit, a reduction in ventilation time and hospitalization, a low rate of atrial fibrillation, blood transfusions compared to conventional CABG, a low requirement for inotropic support, low incidence of respiratory tract infections, stroke, delirium and postoperative myocardial infarction^(2,7).

Aim: A retrospective analysis of the single center immediate and mid-term results of off-pump CABG in patients with multivessel coronary artery disease.

Materials and Methods

This retrospective study included 564 patients with IHD operated in the department of cardiac surgery in the Republican Research Center of Emergency Medicine in 2013-2017. Four hundred and seventy three patients (84%) were male and 91(16%) female, the average age was 56.2 ± 0.9 years. The initial patient data are shown in Table 1.

Most patients, 512 (90.7%), were operated; off-pump, standard deep pericardial stitches, Trandelenburg position, operating table rotations, volume preload and/or cardiotoxic support were used to provide hemodynamic stability. During the procedure, we preferred to use the standard mechanical pressure stabilizer over vacuum stabilizers (Figure 1).

In most cases, (94.8%), the anterior artery was bypassed using the left internal thoracic artery, the mean number of grafted vessels was - 3.2. In 52 cases, we needed to turn on-pump due to several reasons. Of them, in 29 (5.1%) cases, the conversion was made urgently due to severe hemodynamical destabilization. Continuous variables were expressed as mean \pm standard deviation and categorical variables as absolute numbers and percentages. Comparisons were performed with the two-tailed Student's t-test for continuous variables and Fisher's exact test, or χ^2 test for categorical variables. All patients'

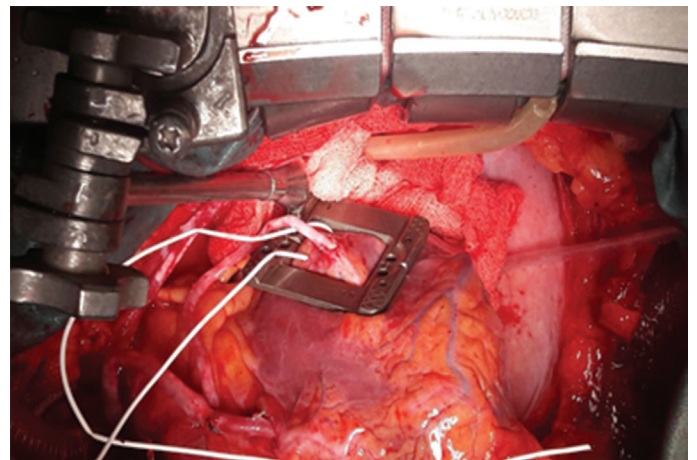


Figure 1. Intraoperative photo. Venous graft on CX artery using simple pressure stabilizer

Table 1. Initial patient characteristics (n=564)

The average age	56.04±0.9 years
Men	473 (84%)
Women	91 (16%)
Unstable angina pectoris	552 (94.6%)
Ongoing acute myocardial infarction	12 (5.4%)
Duration of the disease more than 1 year	468 (82.9%)
Previous AMI	411 (72.8%)
Diabetes Mellitus	384 (68.0%)
Triple vessel disease	424 (75.2%)
Left main stenosis	140 (24.8%)
COPD	203 (35.9%)
EF %	44.6±4.3%

AMI: Acute myocardial infarction, COPD: Chronic obstructive pulmonary disease, EF: Ejection fraction

data used in research were used after the informed consent were obtained. Authors declared no ethical conflicts, and research was approved by the Ethical Committee of the Republican Research Center for Emergency Medicine (registered: 28.11.2018, REG no: 75). Authors declared no conflicts of interest or financial support from the third site.

Results

The immediate results of the hospital period, including hospital mortality and complications of the postoperative period, were evaluated.

In the early postoperative period, 18 patients died, hospital mortality was 3.19%. Among the causes of mortality, there were perioperative myocardial infarction-eight (44.45%) and acute heart failure-eight (44.45%). In two cases (11.1%), the cause of death was septic complications.

In a single-factor analysis, we observed that a history of acute myocardial infarction, diabetes mellitus, and COPD were not a risk factor for death, while an unstable state on admission [Odds ratio (OR)=15.38, confidence interval (CI) =-4.86-48.6 p<0.0001] and conversion to on-pump for emergency indications (OR=30.25, CI=9.46 - 96.7, p<0.0001) could be considered as reliable risk factors for the development of the lethal outcome in the early

postoperative period, a low ejection fraction also showed a high probability of a mortality, but the changes were not statistically significant (OR=1.07, CI=0.44-2.57, p=0.88).

Complicated postoperative period was noted in 77 (13.6%) patients. The heart failure - requiring cardiac support was observed in 23 (4.1%) cases, heart rhythm disorders - in 38 (6.7%) cases. Postoperative bleeding was noted in 6 (1.06%) cases, wound conducted complications in seven cases (1.2%). Ischemic stroke was observed in three patients (0.5%).

The duration of hospital stay in the ICU after surgery was 2.4±0.5 days. The duration of the postoperative period in the clinic was 9.8±0.9 days.

Midterm Outcome

During the follow-up period (2-40 months on average 24.1±0.34), nine (2.4%) patients died, main causes of death were acute heart failure due to myocardial infarction four (1.1%) and gastrointestinal bleeding three (0.8%). Freedom from the combined endpoint of cardiac death and myocardial infarction was 97.1% at 40 months. Kaplan-Meier analysis showed that freedom from recurrent angina was 90.4%. Repeat revascularization was required only in two patients, one patient showed progression of atherosclerosis in native vessels and another showed distal graft stenosis treated effectively by percutaneous coronary intervention - freedom from repeated revascularization was 99.1%.

Discussion

Some recent studies and meta-analyses have proven the safety and effectiveness of off-pump coronary artery bypass (OPCAB) with favorable early outcomes and have described OPCAB as a safe alternative to conventional CABG, regarding to death rate and postoperative morbidity^(2,8,9). Fukui et al.⁽¹⁰⁾ have revealed that the number of distal anastomoses per patient (3.6±1.4) in their study was similar to that in the on-pump patients, and complete revascularization was achieved in 99.2% of patients. In the present study, the number of distal anastomoses per patient

(3.6) was the same as in Fukui et al.⁽¹⁰⁾ study. We can state that complete myocardial revascularization using an off-pump technique can be safely performed. Sabik et al.⁽¹¹⁾ in their work described the equivalent midterm outcomes after off-pump and on-pump CABG, 4-year survival after OPCAB was 87.5%. The results of the present study, with a 40-month survival rate and freedom from cardiac death of 97.1%±0.6%, are almost identical to those of previous studies. The reduction of graft patency can increase the need for repeat revascularization with time. Puskas et al.⁽¹²⁾ revealed that graft patency in OPCAB patients was similar to that in conventional CABG patients at 30 days (99.0% vs 97.7%) and 1 year (93.6% vs 95.8%) after surgery. In the present study, 90.4% of patients complained on angina recurrence, but overall early graft patency rate was 99.1%, what is almost identical to their results. Recent studies have revealed that off-pump to on-pump conversion can be performed in 5-10% of all cases⁽¹³⁾. The rate of performing OPCAB in our isolated CABG patients was 90.8% and overall conversion rate was 9.2% with 5.1% cases being converted urgently due to hemodynamical disturbances. Some studies have underlined that conversion can be an independent risk factor for mortality in early postoperative period^(13,14). Our findings also support these data, mortality rate was higher among urgently converted patients.

In the four largest studies in which off-pump and on-pump CABG were compared - CORONARY (n=2,357 vs 2,337 on)⁽¹⁵⁾; DOORS (n=450 vs 450 on)⁽¹⁶⁾; GOPCABE (n=1271 off vs 1268 on)⁽¹⁷⁾ and ROOBY (n=1,104 off vs 1,099 on)⁽¹⁸⁾ there were no significant differences in the incidence of mortality, myocardial infarction or stroke in the early postoperative period or within 30 days after surgery. In the CORONARY and GOPCABE studies, in the long-term period, there was a higher need for repeated revascularization^(15,17). In the ROOBY trial - data showed the absence of a statistically significant difference in the frequency of repeated CABG rates⁽¹⁸⁾. In conclusion, none of these large studies showed a difference in major clinical outcomes between the off-pump and on-pump

CABG during a 30-day follow-up⁽¹⁵⁻¹⁸⁾. A recent meta-analysis revealed the favorable outcomes of OPCAB^(1,8,9), and concluded that OPCAB should be considered as a safe alternative to conventional CABG with respect to mortality risk. Thus, we suggest that OPCAB should be performed whenever possible in patients undergoing isolated CABG.

Study Limitations

The limitations of our clinical study are that the number of patients was small, and the length of clinical follow-up was relatively short. Another limitation is that this is a single-center and single-surgeon experience.

Conclusions

Patients with multivessel coronary disease and unstable angina in most cases can undergo off-pump CABG with favorable early results. Hemodynamical problems can force surgeon to turn on-pump. Emergent on pump conversion following hemodynamical instability can be a significant factor for mortality. In our series, CABG showed favorable immediate and mid-term results.

Ethics

Ethics Committee Approval: The research was approved by the Ethical Committee of the Republican Research Center for Emergency Medicine (registered: 28.11.2018, REG no: 75).

Informed Consent: All patients' data used in research were used after the informed consent were obtained.

Peer-review: Internally peer-reviewed.

Authorship Contributions

Surgical and Medical Practices: A.A.A., M.O., Concept: A.A.A., Design: A.A.A., Data Collection or Processing: A.A.A., Analysis or Interpretation: A.A.A., M.O., Literature Search: A.A.A., Writing: A.A.A.

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References

1. Afilalo J, Rasti M, Ohayon SM, Shimony A, Eisenberg MJ. Off Pump Vs on Pump Coronary Artery Bypass Surgery: A Meta-analysis and Meta Regression of Randomized Clinical Trials. *Eur Heart J* 2012;33:1257-67.
2. Angelini GD, Taylor FC, Reeves BC, Ascione R. Early and midterm outcome after off-pump and on-pump surgery in Beating Heart Against Cardioplegic Arrest Studies (BHACAS 1 and 2): a pooled analysis of two randomised controlled trials. *Lancet* 2002;359:1194-9.
3. Bittner HB, Savitt MA. Off-pump coronary artery bypass grafting decreases morbidity and mortality in a selected group of high-risk patients. *Ann Thorac Surg* 2002;74:115-8.
4. de Jaegere PP, Suyker WJL. Off pump coronary artery bypass surgery. *Heart* 2002;88:313-8.
5. Joo HC, Youn YN, Chang BC, Yoo KJ. The feasibility and safety of off-pump coronary bypass surgery in emergency revascularization. *J Thorac Dis* 2018;10:2268-78.
6. Gaudino M, Angelini GD, Antoniadis C. Off-Pump Coronary Artery Bypass Grafting: 30 Years of Debate. *J Am Heart Assoc* 2018;7:e009934.
7. Davierwala PM. Current outcomes of off-pump coronary artery bypass grafting: evidence from real world practice. *J Thorac Dis* 2016;8(Suppl 10):S772-S86.
8. Raja SG, Benedetto U. Off-pump coronary artery bypass grafting: Misperceptions and misconceptions. *World J Methodol* 2014;4:6-10.
9. Reston JT, Tregear SJ, Turkelson CM. Meta-Analysis of Short-Term and Mid-Term Outcomes Following Off-Pump Coronary Artery Bypass Grafting. *Ann Thorac Surg* 2003;76:1510-5.
10. Fukui T, Takanashi S, Hosoda Y, Suehiro S. Early and midterm results of off-pump coronary artery bypass grafting. *Ann Thorac Surg* 2007;83:115-9.
11. Sabik JF, Blackstone EH, Lytle BW, Houghtaling PL, Gillinov AM, Cosgrove DM. Equivalent midterm outcomes after off-pump and on-pump coronary surgery. *J Thorac Cardiovasc Surg* 2004;127:142-8.
12. Puskas JD, Williams WH, Mahoney EM, et al. Off-pump vs conventional coronary artery bypass grafting: early and 1-year graft patency, cost, and quality-of-life outcomes: a randomized trial. *JAMA* 2004;291:1841-9.
13. Yoon SS, Bang JH, Jeong SS, Jeong JH, Woo JS. Risk Factors of On-Pump Conversion during Off-Pump Coronary Artery Bypass Graft. *Korean J Thorac Cardiovasc Surg* 2017;50:355-62.
14. Keeling B, Thourani V, Aliawadi G, et al. Conversion From Off-Pump Coronary Artery Bypass Grafting to On-Pump Coronary Artery Bypass Grafting. *Ann Thorac Surg* 2017;104:1267-74.
15. Lamy A, Devereaux PJ, Prabhakaran D, et al. Off-pump or on-pump coronary-artery bypass grafting at 30 days. *N Engl J Med* 2012;366:1489-97.
16. Houliand K, Kjeldsen BJ, Madsen SN, et al. On-pump versus off-pump coronary artery bypass surgery in elderly patients: results from the Danish on-pump versus off-pump randomization study. *Circulation* 2012;125:2431-9.
17. Diegeler A, Börgermann J, Kappert U, et al. Off-pump versus on-pump coronary-artery bypass grafting in elderly patients. *N Engl J Med* 2013;368:1189-98.
18. Shroyer AL, Grover FL, Hattler B, et al. On-pump versus off-pump coronary-artery bypass surgery. *N Engl J Med* 2009;361:1827-37.