Outcome of Intracoronary Shunt in Off-pump Coronary Artery Bypass Surgery in Patients with Low Cardiac Output

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Abstract- Patients with coronary artery disease and left ventricular dysfunction have a high mortality with nonsurgical (medical) treatment. Coronary artery bypass grafting improves survival and the quality of life. Recently, revascularization without cardiopulmonary bypass has been presented as a viable alternative. The aim of this study was to survey the result of coronary artery bypass grafting with off-pump technique using intracoronary shunt in patients with left ventricular ejection fraction≤ 25%. From January 2009 to December 2012, 86 patients with an ejection fraction ≤ 25% (58 males, 28 females) aged 41- 84 years (61.2 ± 3.1 yrs) underwent coronary artery bypass graft surgery with off-pump technique. Grafting was performed as needed with internal mammary artery and saphenous vein. We studied operative and postoperative data. Hospital Mortality was 2.32% (two patients). Postoperative complications were low. Total length of hospital stay was 7.2 days, length of ICU stay 2.1 days, pulmonary complications 3.48% (three patients), postoperative bleeding about 340 cc, acute renal failure 1.16% (one patient) and left-ventricle ejection fraction before discharge was increased about 10% in these patients. Coronary artery bypass grafting without cardiopulmonary bypass with intracoronary shunt in patients with severe left ventricular dysfunction is valid and safe and has low mortality and morbidity.

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Keywords: Coronary artery bypass; Off-pump surgery; Intracoronary shunt

Introduction

Despite several advances in the treatment of coronary artery disease, many patients, with low cardiac output especially those with multivessel disease and complex anatomies, benefit greatly when subjected to surgical treatment. Coronary artery bypass grafting (CABG) with cardiopulmonary bypass (CPB) and cardioplegic arrest is considered the gold standard in intervention but induces an inflammatory reaction and has the potential for induction of multiple-organ dysfunction (1).

Using the technique of myocardial revascularization without cardiopulmonary bypass (off-pump) with intracoronary shunt has several advantages such as: no risk of myocardial ischemia during distal anastomosis on coronary arteries, no time limitation for anastomosis, and no pump complications, which reduces injury to the myocardium and contributes to better results.

In this context, myocardial revascularization with off-pump technique was investigated and had reduced complications related to cardiopulmonary bypass (2).

In The presence of severe left ventricular dysfunction, pulmonary, hepatic and renal dysfunction may be additional risk factors for CABG, but it has been indicated that even in this group of patients, off-pump bypass with intracoronary shunt is safe (3).

The aim of the current study was to assess the safety and efficacy of myocardial revascularization without cardiopulmonary bypass in patients with low cardiac output (<25%) using intracoronary shunt.

Materials and Methods

Between January 2009 and November 2012, 86 patients with an ejection fraction ≤ 25% underwent CABG as an isolated procedure without cardiopulmonary bypass (off-

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pump) with intracoronary shunt. The inclusion criteria were all patients with an echocardiographic ejection fraction ≤ 25% in Behsat and Erfan hospitals, Tehran and operated by the same surgical team.

The decision was made during the operative evaluation based primarily on the severity of cardiomegaly and cardiac dilatation. These patients were excluded from the study and operated by cardiopulmonary bypass without cardiac arrest with intracoronary shunt. Once the decision had been made, standard protocols were followed, including administration of heparin at a dose of 5mg/kg .

In these patients, revascularizations without cardiopulmonary bypass with suction stabilizers as well as intracoronary shunts were used. Additional maneuvers were used during cardiac exposure in order to maintain cardiac output, including the opening of the right pleural space and the use of a deep pericardial traction suture. Distal anastomosis with Continuous 7-0 polypropylene monofilament sutures was performed. CO2 blower aided the visualization of target vessels. Proximal anastomoses were performed using a partial occlusion clamp. Site selection was performed by ascending aorta palpation to avoid plaques. The left internal thoracic artery was used in all cases unless it had no flow after harvesting. The remaining targets received saphenous vein grafts.

Results

The mortality of patients undergoing off pump technique with intracoronary shunt was 2.32% (two patients) postoperative acute myocardial infarction was seen in 1.16% (one patient); reoperation for graft occlusion in one patient (1.16%). Intraaortic balloon pump after the operating in 2.32% (two patients), 3.48% (three patients) had a respiratory problem after the operation that improved with medical treatment. Four patients (4.65%) underwent reoperation for control of bleeding. One patient (1.16%) developed mediastinitis that was controlled with closed continuous normal saline irrigation. We had no neurological complication. Time of coronary artery bypass with off pump method was longer than the pump method. We had a rise in serum CK-MB>30 IU only in four patient. We could follow 78 patients. There was no death; only two patients devolved congestive heart failure which responded to medical therapy.

Table 1. Post operative complications

Complications	No. of the patients (%)
Myocardial infarction	1(1.16)
Post operative bleeding	4(4.65)
Respiratory problem	3(3.48)
Mediastinitis	1(1.16)

Discussion

One of the persistent challenges in coronary disease and low cardiac output is a poor result and high mortality rate after medical treatment (4). CABG in these patients is challenging, with low cardiac output directly reflecting procedure risk and representing an independent risk factor for morbidity and mortality. Interestingly, these patients benefit most from surgical treatment. Although operation with CPB is considered the gold standard, several strategies have been recently used to decrease the complications related to its use and to improve outcomes. Using beating coronary artery bypass with intracoronary shunt has been shown to be safe and effective, and superior to conventional operations (5), even in patients with left ventricular dysfunction.

In current study, with off-pump method incidence of complications such as; postoperative bleeding, transfusion requirements, reoperation for bleeding, acute renal failure, hemodialysis, need for insertion of balloon pump and stroke were very low. A survey in the literature indicates that complications and postoperative mortality in patients with ventricular dysfunction are more when they underwent the procedure with cardiopulmonary bypass (6).

A common finding in the literature is a reduced number of grafts in the procedures performed without cardiopulmonary bypass, which raises questions about revascularization completeness, but in our patients we did the graft as many as were needed, and there were no limitation in number of the graft, and we grafted all coronary arteries as they were needed.

The mortality rate of our patients was 2.32% (two patients), comparable to findings in another series of patients with left ventricular dysfunction operated without cardiopulmonary bypass. However, most of those series involved an ejection fraction above the average found in our series (7).

Most CABG studies in patients with low cardiac output include patients with an ejection fraction below 35 % (8, 9), but in present study we evaluated the result of CABG with off pump method in patient with ejection fraction < 25%. Significant hemodynamics difference was between patients with ejection fractions of 25% and 35%.

Patients with ejection fraction (EF) < 25% who had viable myocardium before the operation, after coronary artery bypass grafting showed a significant decrease in left ventricle diastolic diameter and an increase in left ventricular ejection fraction with significant improvement in NYHA functional class (10).

In patients operated with off-pump method we had fewer pulmonary complications which can be explained by

the possibility of cardiopulmonary bypass inducing pulmonary dysfunction secondary to complement activation, neutrophil sequestration in pulmonary microcirculation and an increase in pulmonary capillary permeability, and interstitial pulmonary edema and is consistent with other study in the literature (11)

We had no neurological complications in the present study. It is better than published findings (1%–5%) showing that most accidents are related to embolic events occurring during cannulation, cardiopulmonary bypass, and aortic surgical manipulation (12).

In our patients after the operation in two patients we had minor renal failure which improved. In patients with CPB method the risk of developing acute renal failure because of decreased perfusion, the absence of pulsatile flow, excessive hemolysis, embolization of platelet aggregates, and fibrin is higher (13).

Among different groups of surgical teams, the result of the operation with off-pump method is different and certain groups achieve unsatisfactory results with the off-pump technique (14). This indicates that the procedure is often highly dependent on the skill of the surgical team in performing beating-heart CABG in patients with low cardiac output.

Finally, in the current study with off-pump method using intracoronary shunt, we could perform CABG in low cardiac output patients and with multiple and significant risk factors for revascularization with low morbidity and mortality after the operation.

Limitations for operation were because of technical limitations in patients with low cardiac output and severe cardiomegaly and severe cardiac dilatation with mild to moderate ischemic mitral regurgitation. CBP was used in these patients for circumflex artery territory, and distal anastomosis was done without cardiac arrest. Anesthesiologic team also is important in this method which must be familiar with this method of operation. We did not have any limitation on the number of graft for anastomosis. Using intracoronary shunt, there is no limitation in time for distal anastomosis. Thus, we had enough time for a good distal anastomosis.

Follow-up includes the in-hospital phase; studies of medium- and long-term effects could not be evaluated completely but in 78 patients who were followed only two patients developed congestive heart failure who responded to medical treatment. In the current study we think that coronary artery bypass with off-pump method using intracoronary shunt is a safe, efficient and low risk, especially in high-risk patients with low cardiac output.

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