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Short term Outcome of Coronary Artery Bypass Surgery in Patients with Impaired Left Ventricular Systolic Function

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Abstrat

Background: Coronary artery bypass graft surgery (CABG) in patients with left ventricular dysfunction was associated with improved survival compared to medical treatment and coronary stenting. However, the risk of surgery is still high. We aimed to evaluate the short-term outcome of CABG in patients with an ejection fraction of ≤ 40%.

Patient and Methods: Forty patients with ejection fraction (EF) ≤40% underwent CABG between December 2015 and August 2019. Patients with moderate to severe mitral regurgitation, concomitant severe liver and kidney impairment, re-operative CABG, who had concomitant procedures with CABG were excluded. The mean age was 56.72±12.44 years; 30 patients (75%) were males. Twenty-six patients (65%) were diabetics, 28 patients (70%) were hypertensive, 18 patients (45%) were dyslipidemic, 22 patients (55%) were smokers, and 4 patients (10%) were obese. The preoperative ejection fraction ranged from 20% to 40%, with a mean of 34.62%

Results: The mean cardiopulmonary bypass time was 90.8 minutes, and ischemic time was 49.8 minutes. Seventeen patients (42.5%) needed inotropic support intraoperatively, and 16 patients (40%) needed an intra-aortic balloon. Five patients (12.5%) had postoperative ischemia, one patient (2.5%) had re-exploration for bleeding, and one patient (2.5%) had acute renal failure. The mean ICU stay was 70.5± 45.63 hours, hospital stay was 8.9± 4 days, and three patients (7.5%) had operative mortality. After 6 months operatively, the ejection fraction improved to reach a mean value of 39.87± 5.02% compared to the preoperative ejection fraction of 32.8± 8.8%. (p<0.001)

Conclusion: Coronary artery bypass grafting can be performed safely in patients with depressed left ventricular function with low short-term morbidity and mortality. CABG could lead to the improvement in the ejection fraction in patients with evidence of viable myocardium.

Key words: Coronary artery bypass grafting; Left Ventricular Systolic Function; low ejection fraction.

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INTRODUCTION

The outcome of coronary artery bypass grafting (CABG) is significantly affected by the left ventricular (LV) function. Despite the improvement in surgical technique, myocardial protection, and postoperative care, the surgical risk of CABG remains high in patients with depressed left ventricular function.[1]

Despite the increased mortality after CABG in patients with decreased left ventricular function, CABG remains the recommended revascularization strategy in those patients, in addition to the diabetics and patients with multi-vessel disease.[2,3] CABG was associated with a better quality of life compared to medical therapy and percutaneous coronary intervention.[4]

The effectiveness of CABG in patients with low ejection fraction has been confirmed in numerous controlled trials, especially if symptoms of angina or ischemia are present.[5,6] The purpose of this study was to evaluate the short-term results after coronary artery bypass grafting (CABG) in patients with left ventricular ejection fraction less than or equal to 40% in our institution.

PATIENTS AND METHODS

Forty patients who underwent CABG with left ventricular ejection fraction (EF) ≤40% between December 2015 and August 2019 were included in the study. The study design is a prospective cohort study. Informed consent was obtained from all patients, and the local Ethical Committee has approved the study.

All patients had a thorough preoperative evaluation, laboratory investigations, and 12 lead ECG. Preoperative echocardiography was performed in all

patients to measure the cardiac chambers, the ejection fraction, regional wall motion abnormalities, hypokinesia, dyskinesia, akinesia, and evaluation of other valves. Coronary angiography was performed for all patients, and the number of diseased vessels and site of lesions were reported.

All patients received their morning dose of cardiac medications. Intramuscular 10 mg morphine sulfate before transfer to the operating theatre was given to all patients. Monitoring started preoperatively using five leads ECG, direct arterial blood pressure, and pulse oximetry.

General anesthesia was used in all patients. A median sternotomy was performed, and the internal thoracic artery was harvested. The Aorto-caval cannulation was then performed, and an aortic root cannula was inserted for cardioplegia administration, venting, and de-airing. Cold intermittent blood cardioplegia was used, the dose was repeated every 25 minutes until the end of distal anastomoses. A (7-0) polypropylene suture was used for distal targets. After completing the last distal anastomoses, the aortic root vent was used to de-air the heart, and the cross-clamp was then removed.

After completion of all anastomoses and establishing a stable intrinsic or paced cardiac rhythm, the patient was weaned from cardiopulmonary bypass. In some instances, mechanical circulatory support in the form of an intra-aortic balloon counterpulsation was needed, according to the hemodynamic profile of the patient. Thoracostomy drainage tubes were carefully placed, usually, in any opened pleural space and the mediastinum, pacing wires were then inserted, and the chest and leg were then closed in layers. We reported the aortic cross-clamp cardiopulmonary bypass time and the number of grafts.

All patients were evaluated thoroughly during their intensive care unit stay, during their hospital stay and after 6 months post-operative. We reported the duration of mechanical ventilation and the length of ICU and hospital stay. Operative complications, including stroke, end-organ dysfunction, and infectious complications, were recorded.

Statistical analysis:

The data were collected, coded, revised, verified, and computerized. Statistical analyses were done using SPSS statistical package version 16. (IBM Corp, Chicago, IL, USA) Qualitative data were presented in the form of numbers and percentages, and quantitative variables as mean, standard deviation (SD) and range. A paired t-test was used to compare the change in the echocardiographic data at 6 months. A P-value of less than 0.05 was considered significant.

RESULTS

The age of our patients ranged from 41 to 74 years, with a mean of 56.72±12.44 years. Thirty patients (75%) were males, and 10 patients (25%) were females. Preoperative data are presented in table 1. Eighteen patients had the New York Heart Association (NYHA) class of IV (45%), 19 patients had class III to IV (47.5%), and 3 patients were in NYHA functional class II to III (7.5%).

	n= 40
Age (years)	56.72±12.44
Males	30 (75%)
Diabetes mellitus	26 (65%)
Hypertension	28 (70%)
Dyslipidemia	18 (45%)
Smokers	22 (55%)
Obesity (Body mass index > 30)	4 (10%)
Ejection fraction (%)	32.8± 8.8
Left ventricular end-systolic diameter (mm)	6.12± 0.52
Left ventricular end-diastolic diameter (mm)	6.7± 0.39

Table 1: Preoperative patients' data. (Continuous data are presented as mean and standard deviation and categorical data as number and percent).

Preoperative ECG revealed that 24 patients exhibited anterolateral ischemia (60%), 8 patients had anteroseptal ischemia (20%), and 8 patients (20%) had anteroseptal and inferior ischemia.

The left ventricular ejection fraction (EF) ranged from 20% to 40%, with a mean of 34.62%. Echocardiographic data are shown in table 1.

One patient had a single-vessel disease (2.5%), 6 patients had a two-vessel disease (15%) 17 patients suffered from three-vessel disease (42.5%), 4 patients had five-vessel disease (10%), and 12 patients had four-vessel disease (30%). Angiographic mapping is shown in table 2.

Cardiopulmonary bypass time ranged from 60 to 130 minutes, with a mean of 90.8 minutes, and ischemic time ranged from 25 to 70 minutes, with a mean of 49.8 minutes.

Seventeen patients (42.5%) received three grafts, 12 patients (30%) had four grafts, 6 patients (15%) had two grafts, 4 patients were found in need for five grafts, and one patient had a single graft.

Seventeen patients (42.5%) needed inotropic support intraoperatively, and 16 patients (40%) needed intra-aortic balloon (IABP).

The left internal mammary artery (LIMA) was grafted to the left anterior descending artery (LAD) in 38 patients (95%), and the saphenous vein was

used in 36 patients (90%) either to LAD or other targets.

	Lesion	n (%)
Left main	Normal	31 (77.5%)
	Critical lesion	7 (17.5%)
	60% lesion	2 (5%)
Left anterior descending	Normal	7 (17.5%)
	Subtotal	25 (62.5%)
	Totally occluded	8 (20%)
Diagonals	Normal	22 (55%)
	Significant lesion	18 (45%)
Ramus intermedius	Normal	6 (15%)
	90% lesion	2 (5%)
	Sub totally occluded	2 (5%)
Circumflex	Normal	22 (55%)
	70% lesion	2 (5%)
	80% lesion	4 (10%)
	90% lesion	5 (12.5%)
	Sub totally occluded	4 (10%)
	Totally occluded	3 (7.5%)
Right coronary	Normal	10 (25%)
	85% lesion	2 (5%)
	Totally occluded	24 (60%)
Posterior descending artery	Normal	36 (90%)
	Significant lesion	4 (10%0

Table 2: Preoperative angiographic mapping. (Data are presented as number and percent)

Postoperative ischemia was encountered in 5 patients (12.5%), two of them (5%) had lateral wall ischemia, and three (7.5%) suffered from anterolateral wall ischemia.

Re-exploration for bleeding was needed in one patient (2.5%), and two patients (5%) had atrial fibrillation. One patient (2.5%) had sternal wound infection, and two patients (5%) had sternal dehiscence. One patient (2.5%) had acute renal failure requiring dialysis. The mean ICU stay was 70.5± 45.63 hours, and hospital stay was 8.9± 4 days. Three patients (7.5%) had operative mortality.

At six months follow up, 4 patients (10%) had lateral wall ischemia, and 2 (5%) had an anterior myocardial infarction. Ejection fraction ranged from 21% to 49%, and the mean was 38.6%. Follow-up echocardiographic data are presented in table 3.

	Preoperative	At 6 months	p
EF (%)	32.8± 8.8	39.87± 5.02	<0.001
LVEDD (mm)	6.7± 0.39	6.69± 0.06	0.66
LVESD (mm)	6.12± 0.52	6.22± 0.43	0.041

Table 3: Comparison of the preoperative and 6 months postoperative echocardiographic data. (Data are presented as mean and standard deviation) (EF: ejection fraction; LVEDD: left ventricular end-diastolic diameter; LVESD: Left ventricular end-systolic diameter).

DISCUSSION

The outcome of CABG in patients with low ejection fraction is the subject of ongoing researches. Currently, CABG is the recommend revascularization methods in patients with depressed ventricular function.[2,3] We performed a study to describe patients who underwent CABG with low ejection and report our institutional experience and outcome.

Obesity is a risk factor for coronary artery disease, and in our study, four patients (10%) were obese, which is consistent with other series.[7] Obesity increased the risk of operative complications and associated with poor long-term outcomes.[5-7] We had a high prevalence of diabetes in our study, which is higher than other reports.[7] Diabetes is strongly associated with coronary artery disease, and long-term outcome of diabetic patients with ischemic heart disease is more favorable when patients have CABG compared to PCI.

Our results showed an increase in EF following CABG; however, there was no evident improvement in cardiac dimensions. The improvement in the EF is consistent with several reports that showed significant improvement in EF following CABG in low EF patients. Samady and coworkers

demonstrated that 65% of low EF (≤30%) patients had a significant increase in LVEF.[8] Bouchart and associates reported a significant increase in EF from 22.2% to 33.5% after CABG[7], and Carr and colleagues assessed the EF at different time points after surgery starting from 1 month to 11 years and recorded a significant improvement in the EF at all the time points.[9] The improvement in EF was reported in several other reports, and this could be attributed to the revascularization of viable myocardium.[10]

The variation in the percentage of increase in EF following CABG may be due to variable mixed areas of scar tissue (fibrosis) and viable myocardium. Therefore, the myocardium showed a different level of improvement in cardiac function after revascularization.[8]

Many authors suggested the theory of a positive association between the amount of viable myocardium before CABG and the possibility of improvement in LV function after CABG.[11] Moreover, Elsasser and colleagues showed that the level of recovery of LV function post CABG is inversely proportional to the extent of fibrosis confirmed by histological examination of the biopsies taken from the hibernating myocardium during CABG.[12]

De Rose and coworkers showed that both the degree and timing of recovery in regional LV function depends on the extent of transmural myocardial fibrosis. Patients having small amounts of viable myocardium showed a significant delay (6-month) in regional LV function improvement after CABG, in comparison to patients who have more quantities of viable myocardium.[13]

Among the 40 coronary bypass procedures we performed, there were 3 total surgical site infections for an overall incidence of 7.5%, one patient had superficial wound infection (2.5%), and the other two patients (5%) had sternal dehiscence. Our results are consistent with other series, which indicate no increase in sternal complication risk in patients with low ejection fraction.[14]

Ridderstolpe and coworkers found that 109 (2.6%) patients developed sternal wound infection following isolated CABG prior to discharge from the hospital. Deep sternal wound infections occurred in 28 (0.7%) patients, while 81 (1.9%) patients have a superficial sternal wound infection.[15]

In this study, there was one patient (2.5%) who developed renal impairment. In a review of over 51000 CABG procedures performed by Bridgewater and associated from 1999 to 2002, the incidence of acute renal failure was constant over the four years, ranging from 4 to 5%. In a 2006 data analysis report from the STS by Santos and coworkers, the incidence of acute renal failure was 3.6% after isolated CABG, and 7.5 and 12.9% after CABG combined with aortic or mitral valve replacement, respectively.

In summary, this study showed that the risk of CABG in patients with low ejection fraction is acceptable compared to the published series and the common standards. Patients with low ejection fraction may benefit from revascularization with an improvement of the ejection fraction during follow-up.

The major limitation of the study was the number of patients included and the lack of a comparison group. Additionally, this is a single-center study, and generalization of the results may be an issue. A larger comparative study is recommended.

CONCLUSION

Coronary artery bypass grafting can be performed safely in patients with depressed left ventricular function with low short-term morbidity and mortality. CABG could lead to the late improvement in the ejection fraction in patients with evidence of viable myocardium.

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