Original Article

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Impact of coronary artery bypass grafting on left ventricular function in patients with low ejection fraction

Praman Sharma[1], Ahmad Shahbaz[2], Javed Iqbal[3], Hafiz Moazam[4]

[1]Resident Punjab Institute of Cardiology, Lahore, [2]Associate Professor, Punjab Institute of Cardiology, Lahore
[3]Associate Professor, Rawalpindi Institute of Cardiology, Rawalpindi,
[4]Assistant Professor, Punjab Institute of Cardiology, Lahore

Author`s Contribution

[1, 2]Drafting the work or revising it critically for important intellectual content,final approval of the version to be published, [3]Substantial contributions to the conception of the work; the analysis and interpretation of data for the work,acquisition of data

Funding Source: None
Conflict of Interest: None

Received:April 6,2020
Accepted:Sept 30,2020

Address of Correspondent
Dr Ahmad Shahbaz
Address. Associate Professor, Punjab Institute of Cardiology, Lahore
drahmadshahbaz@gmail.com

ABSTRACT

Objective: To study the impact of Coronary Artery Bypass Grafting on Left Ventricular Function in patients with low ejection fraction.

Methodology: This observational study was conducted at the Cardiac Surgery Department of Punjab Institute of Cardiology, Lahore from June 2019 to November 2019. 114 patients were selected through Non-probability, consecutive sampling technique. All patients then underwent echocardiography to evaluate LV ejection fraction. Patients then underwent CABG and were followed for left ventricular function i.e., ejection fraction after 5 days of surgery. Left ventricular function was evaluated by using echocardiography. Mean ± standard deviation was calculated for left ventricular function. Preoperative and Postoperative left ventricular function was differentiated by applying paired sample t-test with p-value≤0.05 considered as significant.

Results: The mean age of the study population was 55.57± 8.76 years with an age range of 30 to 70 years. There were 94(82.46%) male and 20(17.54%) female cases with male to female ratio of 4.7:1. The mean weight, height, and BMI were 78.81±12.04 kg, 1.67±0.09m, and 28.27±4.09 respectively. The mean ejection faction before surgery was 32.13 ± 3.94 % and after 5 days of surgery the mean ejection fraction was significantly improved to 36.15± 4.11%, p-value < 0.0001.

Conclusion: The level of left ventricular remodeling determines the functional improvement rate after CABG. Patients undergoing CABG with low ejection fractions have been benefited in the early assessment.

Keywords: CAD, ACS, CABG, left ventricular function, low ejection fraction.

Cite this article as:*Sharma P, Shahbaz A, Iqbal J, Moazam H. Impact of coronary artery bypass grafting on left ventricular function in patients with low ejection fraction. Ann Pak Inst Med Sci.2020; 16(3):128-132.*

Introduction

Coronary artery bypass graft (CABG) surgery is regarded as the premier management for patients having critical triple- vessels disease (TVD) and left main stem (LMS) coronary artery disease (CAD). Also, the most acceptable approach of treatment for the patients with CAD and poor left ventricular (LV) function [ejection fraction (EF) ≤35%] is indistinct.[1,2] At present time CABG surgery is being performed globally for CAD.[3]

Despite various approaches in the management of CAD, a lot of patients with multi-vessels disease and difficult coronary anatomies are hugely benefited fromsurgical intervention. With poor ventricular function, the outcome of surgical treatment is more impressive when compared with both medical treatment or angioplasty.[4]

It has been shown in multiple studies that CABG for poor LV function patients results in significant advancement in prolong survival with quantitative improvements in ejection fractions and New York Heart Association (NYHA) class. In a study, it has been reported that patients with an EF≤30% receiving drugs therapy had a 43% 5-year life expectancy in comparison to 63% 5-year life expectancy in those underwent surgery.[5,6,7]

Over the years, with improvements in myocardial protection, anesthesia, cardiopulmonary bypass (CPB), and postoperative support, operative mortality in this group has significantly decreased (2.4% - 8%.[8,9,10] It was investigated, patients with <40% EF had 9.3% 1month perioperative mortality.[11] Studies done by Christakis in patients with ≤25% EF there was 9.8% operative mortality, and Carr have shown 11% perioperative mortality in patients having EF < 35%. More recently, in patients with EF <30%, in-hospital mortality of 4% has been reported.[10,11,12] This decline in mortality rate over some time shows a distinct improvement from the double-digit rates reported before 1990. But in the local literature, there has been no study available upon which we can rely to implement that CABG is low risk procedure in a case with low EF. In routine patient has to wait for an improvement in EF after ACS to undergoing CABG. So through this study, we want to gain local evidence that can help us in the future that CABG is a safe procedure for ACS patients with low EF. The conclusions and recommendations drawn can provide guidelines to minimize and manage these complications of seriously ill patients.

The rationale of this study is to show the improvement in mean post-operative LV function after CABG in patients presenting with low ejection fraction (EF). CABG is regarded as the superior option for the management of patients with CAD.[17-19]

Methodology

This descriptive study was conducted at the department of cardiac surgery, Punjab Institute of Cardiology, Lahore in six months from June 2019 to November 2019. A total of 114 patients were calculated with a 95% confidence level, 1% margin of error, and taking the magnitude of mean LVEF i.e., 39.66±5.43% in patients undergoing CABG.

Inclusion Criteria: Patients undergoing CABG, patients of both genders and age range 30-70 years, symptomatic severe three vessels coronary artery disease (each vessel has stenosis >50%), patients with critical left main stem disease, patients with EF (<40%), patients with >50% of myocardial viability in LAD, LCX and RCA territory.

Exclusion Criteria: Patients with EF (<25%), patient undergoing emergency CABG, patient with Myocardial Viability <50% in LAD, LCX, and RCA territory, patients with renal impairment (serum creatinine level ≥ 2 mg/dL), Myocardial infarction within the previous 7 days (new changes in ECG and rise in CPK-MB% ≥ 10%) andpatients undergoing concomitant valvular surgery.

Patients were selected through Non-probability, consecutive sampling technique. All patients then underwent echocardiography to evaluate LV ejection fraction. Patients then underwent CABG and were followed for left ventricular function i.e. ejection fraction after 5 days of surgery. Left ventricular function was evaluated by using echocardiography. All this information was entered on predesigned proforma. Data analysis was done through SPSS version 21. Mean ± standard deviation was calculated for the left ventricular function. Preoperative and Postoperative left ventricular function was differentiated by applying paired sample t-test with p-value≤0.05 considered as significant

Results

The mean age of cases in this study was 55.57± 8.76 years with minimum and maximum age of 30 and 70 years. The mean weight, height, and BMI was 78.81 ± 12.04 kg, 1.67±0.09cm, and 28.27±4.09 respectively. (Table 1)

The mean ejection faction before surgery was 32.13 ± 3.94 % and after 5 days of surgery the mean ejection fraction was significantly improved to 36.15± 4.11%, p-value < 0.0001. (Table III)

Significant improvement was seen in ejection fraction after procedure in each stratum of age, p-value <0.000112. Significant improvement was seen in ejection fraction after procedure in obese and non-obese, p-value <0.0001. Significant improvement was seen in ejection fraction using on-pump or off-pump procedure, p-value <0.0001. (Table IV)

Table I: Descriptive statistics of age (years)

	Age (years)	Weight (kg)	Height (cm)	Body mass index
Mean	55.57	78.81	1.67	28.27
S.D	8.76	12.04	0.09	4.09
Range	40	52	.59	18.70
Minimum	30	50	1.26	17.30
Maximum	70	102	1.85	36.00

Table II: Descriptive statistics of Risk Factors, Intra and post-operative variables

	YES	NO
Diabetes Mellitus	62	52
IHD	79	35
Hypertension	70	44
Smoking	35	79
Hyperlipedemia	96	18
CPB time	67.82 ± 21.45	
Cross Clamp time	40.80 ± 16.99	
Mortality	<0.001	

Table III: Comparison of ejection fraction % before and after surgery

	Ejection Fraction (%)	
	Before surgery	After 5 days
Mean	32.13	36.15
S.D	3.94	4.11
Range	15	20
Minimum	25	25
Maximum	40	45
Paired sample t-test = -9.98 **p-value< 0.0001**		

Discussion

In patients with CAD, LV dysfunction is not always recoverable related to the previous infraction, many studies had shown there is marked improvement in LV function and even normalize in many patients after CABG. In patients with poor LV function, CABG has proven to be quite beneficial than medicaltreatment alone, resulting in significant clinical improvement and also improving long-term survival.[5] CABG has shown to improve survival in left main disease and certain subgroups with multi-vessel disease. Concerning the pivotal studies that assessed survival with CABG versus medical treatment included the Veterans Administration (VA) cooperative study, the Coronary Artery Surgery Study (CASS), and the European Coronary Surgery Study (ECSS).[13]

The STICH trial (H_1) (Surgical Treatment for Ischemic Heart Failure) later assessed survival in the patients with poor LV function (EF ≤35%) after CABG, demonstrating a remarkable survival benefit in the extended-follow-up results.[14]The result of CABG on LV systolic function remains elucidated. While the STICH trial examined the result of CABG in severe LV dysfunction (EF ≤35%) patients. The STICH trial marked a noticeable reduction in end-systolic volume index (ESVI) in patients with a baseline LV ESVI >90 mL/m2, while no obvious change in LV ESVI was seen in the subgroups of patients with smaller LV cavity size. While LVEF significantly improved in patients with a baseline LV ESVI ≥60 mL/m2, no obvious improvement in LVEF was noticed in those with a baseline LV ESVI <60 mL/m2.[8]

The mean age in the current study was 55.57± 8.76 years with minimum and maximum age of 30 and 70 years. There were 94(82.46%) male and 20(17.54%) female cases with male to female ratio of 4.7:1. A study reported similar male predominance i.e. there were 81.3% male and 18.8% female cases. There were 62 diabetic patients, 70 hypertensive, and 35 smokers in our data. The authors discovered single-vessel pathology exist in 1/40 (2.5%), double -vessel pathology 16/40 (40%), triple-vessel pathology in 17/40 (42.5%) and four -vessel pathology in 6/40 (15%) of patients.[15,16]. We in this found that a total of 10(8.77%) cases had single, 41(35.96%) had double and 63(55.26%) had multi-vessel disease. These findings are comparable regarding multi-vessel disease.

Table IV: Comparison of ejection fraction before and after surgery with respect to age

Parameters	Age (years)	Before		After		p-value
		Mean	S.D	Mean	S.D	
Ejection Fraction (%)	**30-50**	33.71	3.58	36.23	4.06	<0.0001
	51-70	31.53	3.92	36.12	4.15	
	Gender					
Ejection Fraction (%)	**Male**	32.08	4.00	35.76	4.20	<0.0001
	Female	32.36	3.69	38.00	3.15	
	BMI					
Ejection Fraction (%)	**Obese**	32.76	4.33	36.95	4.11	<0.0001
	Non-obese	31.78	3.69	35.72	4.07	
	Procedure					
Ejection Fraction (%)	**On-pump**	32.02	3.98	36.28	4.17	<0.0001
	Off- pump	32.63	3.76	35.47	3.81	

In 2017, the Minneapolis Veteran Affairs Health Care System conducted a study on 2,838 consecutive patients who underwent isolated CABG. Out of these, 375patients had an echocardiographic study for LV function preoperatively (within 6 months) and postoperative (3 to 24 months) of CABG. The study result has illustrated that while the mean LV ejection fraction (LVEF) did not improve after CABG (49±13)% *vs*. (49±12)%, LVEF reduces in the subgroup with normal (≥50%) pre-operative LVEF from (59±5)% to (56±9)% and improved in those with decreased (<50%) pre-operative LVEF from (36±9)% to (41±12)%, P<0.001. LVEF improved by >5% in 24% of the study population, did not change (+/− 5%) in 55%, and worsened by >5% in 21%. Patients with improved EF were less often diabetic and had lower pre-operative LVEF, and greater LV dimensions at baseline.[17] We also observed that the mean ejection faction before surgery was 32.13 ± 3.94 % and after 5 days of surgery the mean ejection fraction was significantly improved to 36.15± 4.11%, p-value < 0.0001. There was no effect of age, gender, obesity, and diabetes mellitus on the improvement of ejection fraction.

Similarly, another research was conducted to estimate the result of poor ejection fraction on clinical outcome after surgery and to calculate the experience with CABG in patients with poor ejection fraction. The research has analyzed the data of 35 patients with EF <35%. EF improved in 78% of patients. Canadian Cardiovascular Society Angina class improved in 42% of patients. Hence, the study findings had decided that in patients with CAD and low EF, CABG can be carried out safely, and improvement in LV function can be achieved with this procedure improving the quality of life.[18] These results are consistent with this study.

Likewise, in another study in patients with poor LV function and poor ejection fraction <35% with aorto-coronary bypass grafting, myocardial revascularization remains controversial because of mortality, morbidity and quality of life. 40 patients with CAD and poor LV function (ejection fraction <35%) underwent CABG in 3 years.[15,16] LV ejection fraction measured preoperatively was 18%-27% and postoperatively was 31%, 08% improvement in 30 days time period. Thus the study has concluded that in patient with poor LV function CABG can be conducted safely with the advancement in quality of life and LV function.[16]

In 2006, a study was performed to evaluate the results of patients with poor LV function undergoing CABG.

Result of consecutive 115 patients with poor LV function (ejection fraction ≤ 30%, mean 22 ± 6%) for CABG only between 1995 to 2000 were compared to 2335 patients with ejection fraction >30% (HEF). Data revealed that patients in the poor LV function group had a higher incidence of diabetes, chronic obstructive pulmonary disease, peripheral vascular disease, previous MI, congestive heart failure, and few elective procedures compared to the HEF group. Despite these higher risk factors, the death rate (LVD 2.6% vs. HEF 1.2%), stroke (2.6% vs. 1.0%), and intraoperative MI (0.9% vs. 0.7%) did not statistically vary within these patients. Whereas the respiratory complications (14.8% vs. 1.9%), renal complications (5.2% vs. 1.0%), and vascular complications (5.2% vs. 0.5%) was remarkably higher in the poor LV function patients, causing prolonged admission (8 ± 8 vs. 6 ± 4 days). Poor LV ejection fraction was not the reason for hospital death. CABG can be considered as a safe and effective approach in patients with IHD and poor LV function. If Mitral valve pathology is present, intervening at the time of initial operation is advisable.[19]

Conclusion

The level of left ventricular remodeling determines the functional improvement rate after CABG. Patients undergoing CABG with low ejection fractions have been benefited in the early assessment.

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