CODEN [USA]: IAJPBB ISSN : 2349-7750

INDO AMERICAN JOURNAL OF
PHARMACEUTICAL SCIENCES
SJIF Impact Factor: 7.187

Avalable online at: http://www.iajps.com *Research Article*

STUDY TO DETERMINE THE OUTCOMES OF CABG VS PCI FOR CORONARY ARTERY DISEASE AND LEFT VENTRICULAR DYSFUNCTION

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Article Received: November 2020 **Accepted:** December 2020 **Published:** January 2021

Abstract:
Introduction*: The effectiveness of coronary artery bypass graft (CABG) and percutaneous coronary intervention (PCI) in patients with coronary artery disease has been well established in randomized controlled trials. However, patients with severe left ventricular dysfunction (ejection fraction <35%) were under-represented in these studies and the management of these complex patients remains unclear. The aim of the study was to compare the treatment results in patients with coronary artery disease and left ventricular dysfunction undergoing CABG and PCI.*
Place and Duration: *In the cardiac Surgery Department of Allied Hospital Faisalabad for three-years duration from June 2017 to June 2020.*
Methods: *2,925 patients with coronary disease and left ventricular dysfunction undergoing CABG (n [1,326) or PCI (n [1599) were evaluated. Patients were matched for propensity to obtain comparable subgroups among patients with left ventricular dysfunction.*
Results: *Analysis of Cox proportional hazards in the propensity-matched subgroups showed that CABG was significantly associated with a lower rate of repeat revascularization and better survival compared to PCI. Other significant independent predictors of poor long-term survival included age, renal failure, heart failure, diabetes, peripheral vascular disease, previous myocardial infarction, left coronary artery disease, and prior CABG.*
Conclusions: *In patients with coronary artery disease and left ventricular dysfunction, CABG was associated with a lower rate of revascularization and improved survival after PCI, taking into account differences in the baseline risk profile. More research is needed on the factors that lead to a specific revascularization method in this patient population.*
Key words: *coronary artery disease, left ventricular dysfunction, CABG, revascularization.*

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Please cite this article in press Abdullah Naeem et al, ***Study To Determine The Outcomes Of CABG Vs PCI For Coronary Artery Disease And Left Ventricular Dysfunction.,*** *Indo Am. J. P. Sci, 2021; 08(1).*

INTRODUCTION:

Patients with left ventricular dysfunction (ejection fraction <35%) and coronary artery disease (CAD) present a clinical challenge. Many randomized controlled trials and observational studies have shown that both coronary artery bypass graft (CABG) and percutaneous coronary intervention (PCI) in patients with CAD are associated with improved survival compared to medical treatment [1-2]. However, in these studies, patients with severe left ventricular dysfunction (LVD) were under-represented. More recent studies such as Synergy Between PCI With TAXUS and Cardiac Surgery (SYNTAX) have provided valuable insight into how the complexity of coronary artery disease affects treatment outcomes, but once again failed to recruit a significant proportion of LVD patients [3-4]. Technological advances have led to more and more LVD patients being referred for revascularization. However, there is no literature comparing CABG with PCI in patients with CAD and LVD [5-6]. No current large cohort studies or prospective randomized trials comparing the long-term survival of patients with PCI and CABG with CAD and LVD have been published [7-8]. The main objective of this study was to evaluate the long-term PCI and CABG outcomes in patients with CAD and LVD using a provincial database. A secondary goal was to identify other significant predictors of poor long-term survival in CAD and LVD patients undergoing revascularization.

PATIENTS AND METHODS:

This study was held in the cardiac Surgery Department of Allied Hospital Faisalabad for three-years duration from June 2017 to June 2020. Patients are enrolled at the time of angiography and are followed prospectively for outcomes including subsequent revascularization. In addition, during cardiac catheterization, demographic data are collected, including age and gender, presence or absence of a history of myocardial infarction, congestive heart failure, cerebrovascular disease, peripheral vascular disease, chronic lung disease, elevated creatinine levels, renal dialysis, hyperlipidemia, hypertension. arterial disease, liver disease, gastrointestinal disease, neoplastic disease, indications for revascularization, the extent of CAD, procedure data, and adverse event data. Data from the database is reviewed as part of the data enrichment process to ensure data completeness, especially in terms of basic patient characteristics, and to verify comorbidities. Patient mortality is updated quarterly in the registry using relevant statistics. The Health Research Ethics Committee approved this research project and found it acceptable within the limits of human experimentation. Consent was withdrawn because no individual patient was identified in the study. In this study, cardiac catheterization or echocardiography or both were used to measure EF. The study enrolled 2,925 consecutive LVD and CAD patients who had isolated CABG or PCI. Patients undergoing concurrent cardiac surgery, transplant recipients and emergency surgery were excluded from this cohort. In 83% of cases, CABG surgery consisted mainly of implanting an internal thoracic artery graft into the left anterior descending coronary artery. Also, in this population, less than 1% of patients had CABG surgery performed without the use of cardiopulmonary bypass. As availability became widespread, DES became the preferred choice over bare metal stents in high-risk cases such as described in this study. Baseline categorical variables were compared between the two groups using X2 tests for categorical data and t tests to compare the continuous baseline characteristics of CABG and PCI-treated patients. SPSS 19.0 was used for data analysis.

RESULTS:

The study trial included 2925 consecutive patients with CAD (significant CAD involving two or more coronary arteries) and LVD. Of these patients, 1,326 underwent isolated CABG and 1,599 - PCI. The basic demographic data are summarized in Table 1

Independent Variables	CABG (n ¼ 1,326)	PCI (n ¼ 1,599)	p Value
Age in years, mean	65.9	65.0	0.03
Male	84.6	76.5	< 0.001
Pulmonary disease	20.8	16.1	0.001
Cerebrovascular disease	10.1	8.3	0.09
Renal disease	4.8	4.9	0.81
Heart failure	46.2	39.3	< 0.001

Diabetes mellitus	38.6	26.8	< 0.001
Smoker, current	32.2	32.0	0.92
Smoker, ever	44.4	36.7	< 0.001
Dialysis	1.8	1.2	0.16
Hypertension	65.5	56.5	< 0.001
Hyperlipidemia	64.4	55.8	< 0.001
Liver/gastrointestinal disease			
Malignancy	3.2	3.9	0.30
Peripheral vascular disease	14.2	7.6	< 0.001
Prior myocardial infarction	63.6	61.4	0.23
Prior PCI	6.8	8.3	0.13
Prior CABG	3.8	9.0	< 0.001
Prior lytic therapy	6.6	13.6	< 0.001
Indication for catheterization			
Myocardial infarction	38.7	64.6	
Stable angina	22.5	12.4	< 0.001
Unstable angina	21.4	14.2	
Other	17.3	8.8	
Coronary anatomy			
Low risk, 1- or 2-vessel disease	8.7	47.9	
High risk, 3-vessel disease	60.6	46.7	< 0.001
Left main	30.2	5.0	
Missing	0.5	0.5	
Ejection fraction <20%	9.7	12.1	0.03

Statistically significant differences between the groups included males, as well as chronic obstructive pulmonary disease, diabetes mellitus, peripheral vascular disease, congestive heart failure, hypertension, and hyperlipidemia in patients undergoing CABG surgery. Patients undergoing PCI had a higher incidence of stable angina, prior CABG, and prior lytic therapy, suggesting that patients undergoing CABG initially had a higher risk of mortality than patients undergoing PCI. However, the CABG and PCI groups are quite different, so comparing these groups prior to propensity matching would not be a valid comparison. Therefore, Table 2 summarizes the fit of the propensity of this cohort to the 22 baseline characteristics.

Table 2. Baseline Characteristics After Propensity Matching

Independent Variables	CABG (n ¼ 718)	PCI (n ¼ 718)	p Value
Age in years, mean	65.6	65.5	0.87
Male	82.3	80.4	0.34
Pulmonary disease	18.7	19.6	0.64
Cerebrovascular disease	9.5	8.8	0.65
Renal disease	5.3	5.2	0.91
Heart failure	43.7	44.3	0.84
Diabetes mellitus	34.4	34.8	0.87
Smoker, current	30.9	31.5	0.82
Smoker, ever	43.2	39.1	0.12
Dialysis	2.1	1.9	0.85
Hypertension	62.5	64.2	0.51
Hyperlipidemia	61.6	61.7	0.96
Liver/gastrointestinal disease	4.7	6.4	0.17
Malignancy	3.1	3.2	0.88
Peripheral vascular disease	11.1	10.7	0.80
Prior myocardial infarction	64.6	66.7	0.40
Prior PCI	7.8	8.6	0.57
Prior CABG	6.5	6.1	0.75
Prior lytic therapy	9.6	9.5	0.93
Indication for catheterization			
Myocardial infarction	52.6	53.1	
Stable angina	16.6	17.1	0.98
Unstable angina	18.5	17.8	
Other	12.3	12.0	
Coronary anatomy			
Low risk, 1- or 2-vessel disease	16.3	17.2	
High risk, 3-vessel disease	73.5	72.3	0.89
Left main	9.6	9.9	
Missing	0.6	0.5	
Ejection fraction <20%	11.1	10.3	0.61
Repeat CABG or PCI	5.7	26.7	< 0.001

The unadjusted survival time for CABG patients with propensity matched versus PCI patients at 30 days, 1 year, and 5, 10 and 15 years was 95% versus 93% (p = 0.10), 91% versus 86% (p = 0.002) 79% versus 74% (p = 0.013), 69% versus 67% (p = 0.366) and 68% versus 65% (p = 0.342), respectively, as shown in Figure 1. Particularly, these differences were significant 1 and 5 years after revascularization. In addition, in the propensity-matched cohort, CABG was mainly performed with the internal thoracic artery transplant to the left anterior descending coronary artery in 91% of all cases. Table 3 shows the uncorrected and adjusted Cox proportional survival hazard ratios.

Survival (Years)	Unadjusted PCI:CABG	HR 95% Lower	CI Upper	Adjusted PCI:CABG	HR 95% Lower	CI Upper
1	1.67	1.21	2.9	1.98	1.43	2.76
5	1.34	1.08	1.66	1.48	1.18	1.85
10	1.15	0.96	1.38	1.21	1	1.47
15	1.16	0.97	1.38	1.21	1	1.46

DISCUSSION:

Overall, previous studies have shown that PCI and CABG are effective therapies for the treatment of CAD [9]. Numerous randomized trials and observations comparing CABG and PCI in patients with preserved ventricular function confirm both forms of revascularization. As mentioned earlier, patients with reduced EF were excluded from these larger studies [10-11]. Currently, registries and case series indicate acceptable perioperative mortality and good long-term outcomes in LVD patients undergoing CABG. Similarly, data from these registries also support the use of PCI in these patients, but unfortunately most of them are not under long-term follow-up. Moreover, the renewed interest in revascularization options in patients with CAD and LVD is partly due to the many advances in cardiac intervention and cardiac surgery over the past 15 years [12]. Previously published data from these registries are confused by the improvements in CABG outcomes (eg, Better graft patency) and PCI outcomes (eg, DES). In this study, CABG patients had a higher incidence of risk factors for poor outcome, including chronic lung disease, diabetes, peripheral vascular disease, congestive heart failure, hypertension, and hyperlipidemia compared to patients undergoing PCI; these results were similar to the results of a study by Appoo and colleagues [13]. Regardless, this and another study continues to prove that CABG produces favorable long-term outcomes for LVD patients. Moreover, in the analysis of the matched propensity after CABG or PCI, there were no significantly different indications for cardiac re-catheterization in terms of recurrence of stable angina, acute coronary syndrome (unstable angina, non-ST segment elevation myocardial infarction, and myocardial infarction with ST segment elevation), congestive heart failure and severe arrhythmia. However, our predisposition-matched subgroups showed that CAD and LVD patients whose first revascularization procedure is PCI have a significantly higher rate of repeat revascularization procedures compared with those whose first revascularization procedure is CABG. In addition, when comparing the revascularization method in patients with CAD and LVD, we showed that CABG is associated with a survival advantage compared to PCI after adjusting for the risk profile at 15 years of follow-up (corrected HR 1.21, 95% CI: 1.00 to 1.46). The difference in survival time, along with significantly lower rates of revascularization, demonstrated in this study, supports a surgical to patients with CAD and LVD. It should be noted, however, that the survival advantage and lower rates of CABG revascularization in CAD patients with LVD compared to PCI must also take into account patient selection. In other words, it is possible that some PCI patients were likely considered poor candidates for surgery due to comorbidities not included in our database (e.g., weak, weak target vessels) that excluded them from CABG surgery. Moreover, there may have been patients in whom PCI was preferred over CABG, e.g., those who had one or more heart operations. Moreover, as identified in our study, many variables remain independently predictive of poor long-term survival, including chronic obstructive pulmonary disease, renal failure, congestive heart failure, diabetes, and peripheral vascular disease. Importantly, these other predictors of poor long-term survival indicate that the choice of revascularization cannot be uniformly made on the basis of the mere presence of CAD and LVD.

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