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Original Article

Prognostic Impact of Previous Percutaneous Coronary Intervention on the Outcome of Coronary Artery Bypass Grafting in Multivessel Disease Diabetic Patients

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Abstract

Background: Previous studies suggest that patients who receive percutaneous coronary intervention (PCI) are at a higher risk of undergoing coronary artery bypass grafting (CABG). This study aimed to investigate the risk of CABG in patients with a history of PCI.

Methods: One hundred diabetic patients who underwent CABG from October 2020 to February 2022 were enrolled and divided into two groups. Group I consisted of 50 patients with no prior PCI, while Group II comprised 50 patients with a history of PCI.

Results: The mean age was 57.4 ± 8.67 years for Group I and 59.72 ± 7.5 years for Group II (p= 0.155). The mean cardiopulmonary bypass time was 108.56 ± 34.53 minutes for Group I and 127.4 ± 35.93 minutes for Group II (p=0.009). The ischemic duration was 75.68 ± 19.94 minutes for Group I and 75.12± 23.02 minutes for Group II. The mean number of grafts was greater in Group I (3.5 (3 – 3.5) vs. 3 (2 – 4), p= 0.011). The mean ventilation time was 9 (5 – 13.75) hours for Group I and 10 (5 – 19) hours for Group II. The mean length of ICU stay was 1 (1–2) day for Group I and 2 (2–3) days for Group II (p<0.001). The length of hospital stay was 8 (7–9) days for Group I and 10 (9–11) days for Group II (p<0.001). There were statistically significant differences between the groups in terms of MACE (higher in the PCI group, p=0.046), improvement in wall motion abnormalities (higher in the non-PCI group, p=0.007), and postoperative normal ejection fraction (higher in the non-PCI group, p=0.032). There was no significant difference in hospital mortality between the two groups (0 vs 3), with a p value =0.07.

Conclusion: A previous PCI could increase post-CABG morbidity and MACEs. However, no significant difference in postoperative mortality rates was found between patients who underwent prior PCI and those who did not.

KEYWORDS

Percutaneous coronary intervention; Coronary bypass grafting; Diabetes mellitus

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Introduction

The suitability of percutaneous coronary intervention and coronary artery bypass grafting (CABG) for revascularization in patients with multivessel coronary artery disease is debated. Despite advancements in stenting techniques, CABG remains the preferred approach for most patients due to its superior long-term outcomes [1]. The most effective revascularization approach for patients affected by coronary artery disease (CAD) with multiple damaged coronary vessels has become a debatable and important issue for both patients and medical professionals, as well as regulatory entities. Despite some methodological limitations in comparing the two approaches, CABG and PCI demonstrated similar long-term survival rates after five years. As a result, there was a notable increase in the utilization of PCI and, simultaneously, a significant decrease in the use of CABG [2]. CABG and the PCI are both considered measures designed for revascularization. However, only CABG can prolong the life of patients with stable CAD. Therefore, CABG and PCI may have different mechanisms. Myocardial viability and/or recognition of ischemia to plan revascularization have been unable to predict the management consequences of PCI or CABG precisely, necessitating coronary intervention procedures to increase survival. Avoiding a myocardial infarction can rescue lives.

Nevertheless, non-flow-limiting stenoses are the primary contributors to most myocardial infarctions, and PCI is necessary only for flow-limiting lesions. Thus, it cannot be reliably predicted that the PCI can significantly reduce the likelihood of new myocardial infarctions. Conversely, CABG may achieve this effect by supplying flow distal to vessel occlusions. Most comparisons between CABG and PCI or medical therapy indicated higher survival rates for CABG and fewer incidences of infarction. CABG may vary from PCI by supplying "surgical collateralization," thereby extending life and preventing new infarctions [3]. Advancements in technology necessitate a reevaluation of the benefits of coronary artery bypass surgery and PCI. The SYNTAX multicenter prospective randomized trial was also conducted to evaluate the best therapy for patients referred to surgeons and interventional cardiologists [4]. The studies unequivocally confirmed that there was no variation between the two treatment methods concerning nonfatal myocardial infarction and mortality. However, prior bare metal or drug-eluting stent implantation necessitates further revascularization procedures due to restenosis [5]. There is a genuine but limited need for emergent CABG after PCI, with unsatisfactory results in patients who have suffered from myocardial infarction [6]. It is widely believed that a history of PCI may increase the risk of CABG. However, conflicting evidence exists regarding the influence of prior PCI on CABG outcomes, with certain studies indicating increased morbidity and mortality rates, while others do not report significant differences [7]. Thus, this study aimed to determine the predictive influence of prior PCI on the outcomes of CABG in diabetic patients with multivessel coronary artery disease.

Patients and Methods

Design and patients

This was a prospective comparative study of diabetic patients with multivessel disease who underwent CABG. The study was carried out after obtaining the approval of the local ethics committee, and written consent was obtained before enrollment. One hundred diabetic patients who underwent CABG from October 2020 to February 2022 were included. Patients were grouped into Group I, which included 50 patients who had not undergone stent placement (non-PCI Group), whereas Group II was composed of 50 patients who had a history of stent placement (PCI Group).

This study focused on short-term clinical outcomes and safety by monitoring intraoperative and postoperative complications. Early clinical outcomes were defined as postoperative outcomes during the hospital stay.

The study included diabetic-controlled patients who were receiving oral hypoglycemic drugs and were scheduled for elective CABG, with or without prior PCI history. We excluded patients diagnosed with single vessel disease and who

Table 1: Comparison of preoperative data between diabetic patients who underwent CABG with no history of prior PCI (Group I) and those with a history of PCI (Group II)

	Group I(n=50)	Group II(n=50)	P value
Age (years)			
Range.	30 – 72	40 – 77	0.155
M±SD	57.4 ± 8.67	59.72 ± 7.5	
Gender			
Male	38 (76.0%)	41 (82.0%)	0.461
Female	12 (24.0%)	9 (18.0%)	
BMI (kg/m2)			
Range.	25.1 – 34.9	25.6 – 34.8	0.098
M±SD	30.09 ± 2.95	31.03 ± 2.63	
Risk factors and comorbidities			
Diabetes mellitus	50 (100.0%)	50 (100.0%)	1.0
Dietary treated	13 (26.0%)	7 (14.0%)	0.259
Insulin treated	20 (40.0%)	20 (40.0%)	
orally treated	17 (34.0%)	23 (46.0%)	
Hypertension	43 (86.0%)	41 (82.0%)	0.585
Hyperlipidemia	35 (70.0%)	36 (72.0%)	0.826
Obesity	27 (54.0%)	35 (70.0%)	0.099
Smoking	15 (30.0%)	18 (36.0%)	0.523
History of stroke	10 (20.0%)	11 (22.0%)	0.806
COPD	13 (26.0%)	11 (22.0%)	0.640
Peripheral vascular disease	13 (26.0%)	15 (30.0%)	0.656
Renal disease	11 (22.0%)	11 (22.0%)	1.0
EuroSCORE II			
Median (IQR)	2 (2 – 3)	3 (2 – 3)	0.246
Range	1 – 6	1 – 6	
NYHA class			
Class1	2 (4.0%)	5 (10.0%)	0.740
Class2	30 (60.0%)	20 (40.0%)	
Class3	8 (16.0%)	9 (18.0%)	
Class4	10 (20.0%)	15 (30.0%)	
Cardiac history			
Angina CCS III-IV	5 (10.0%)	7 (14.0%)	0.538
MI <4 weeks prior	17 (34.0%)	22 (44.0%)	0.305
Time interval, PCI-CABG		4 (1 – 13)	
LVEF (%)	57.43 ± 12.85	54.15 ± 13.41	0.214

NYHA= New York Heart Association, COPD= chronic obstructive pulmonary disease, CRI= chronic renal impairment, MI= myocardial infarction, CABG= coronary artery bypass grafting, PCI= percutaneous coronary intervention, M±SD= mean ± standard deviation, IQR= interquartile range

underwent CABG in conjunction with other cardiac procedures. Those who required emergency CABG procedures and those who required redo procedures were excluded. Furthermore, the presence of significant stenosis in the carotid artery along with GABG and preoperative comorbidities such as hepatic, renal, and pulmonary conditions were also excluded.

Data

Demographic information, medical history, and complete clinical data were recorded alongside laboratory and radiological examinations. Echocardiography data were collected before the surgery. Operative data, including the aortic cross-clamp time, total bypass time, number of grafts, and need for an intra-aortic balloon pump, were recorded. Postoperative data consisted of duration of ventilation, requirement for inotropes, use of IABP, and length of stay in the ICU and hospital.

Study endpoints

The primary study endpoint was all-cause in-hospital mortality. The secondary endpoints were the major adverse cardiac event (MACE) rate, which included perioperative myocardial infarction (PMI), low cardiac output syndrome (LCOS), cardiac death, and postoperative morbidities, including reopening for bleeding, wound infection, and inotropic support.

Statistical analysis

The information was gathered, reviewed, validated, and edited using a personal computer. The data were subsequently examined with Microsoft Office 2016 (Microsoft, CA, USA) and Statistical Package for Social Science (SPSS) version V23 (IBM Corp, Chicago, IL, USA). Continuous variables are expressed as the mean and standard deviation and were compared within each group using paired sample t tests during the preoperative, operative, and postoperative stages. Categorical variables are expressed as absolute and relative frequencies (percentages) and were compared with the chi-square or Fisher exact test. A P value < 0.05 was considered to indicate statistical significance.

Results

Preoperative data

The mean age of the participants in Group I was 57.40 ± 8.52 years, while that in Group II was 59.72 ± 7.5 years (p= 0.155). No statistical significance was found regarding sex distribution (p=0.49). There was no significant difference in the baseline data, such as smoking status, hypertension status, dyslipidemia status, or family history (Table 1). The New York Heart Association (NYHA) dyspnea grade did not significantly differ between the two groups (p =0.47). There was no significant difference in preoperative comorbidities between the two groups. Additionally, the EuroSCORE was not significantly different between the groups (Table 1).

Operative data

The mean cardiopulmonary bypass time was 108.56± 34.53 minutes for Group I and 127.4 ± 35.93 minutes for Group II (p=0.009). The ischemic time was 75.68± 19.94 minutes for Group I and 75.12± 23.02 minutes for Group II. The reperfusion time was 27 (Q1- Q3: 17 – 42.75) for Group I and 34 (21.75 – 49.75) for Group II, with no statistically significant difference between the two groups (Table 2). The mean number of grafts was greater in Group I (3.5 (3 – 3.5) vs. 3 (2 – 4), p= 0.011).

Table 2: Comparison of the operative data between diabetic patients who underwent CABG and had no history of prior PCI (Group I) or history of PCI (Group II). The data are presented as the number (%), mean (SD), or median (Q1-Q3)

	Group I (n=50)	Group II (n=50)	P value
CPB time (min)			
Range	47 – 166	57 – 192	0.009^*
M±SD	108.56 ± 34.53	127.4 ± 35.93	
ACC time (min.)			
Range	33 – 108	29 – 109	0.897
M±SD	75.68 ± 19.94	75.12 ± 23.02	
Reperfusion time (min)			
Range	8 – 58	11 – 59	0.098
M±SD	27 (17 – 42.75)	34 (21.75 – 49.75)	
Number of grafts			
Median (IQR)	3.5 (3 – 3.5)	3 (2 – 4)	0.011
Number of distal anastomoses			
Median (IQR)	4 (3 – 5)	3 (2 – 4)	0.188

ACC: aortic cross-clamp time, CPB: cardiopulmonary bypass time, CABG: **coronary artery bypass grafting,** PCI: **percutaneous coronary intervention**

Table 3: Comparison of postoperative data between diabetic patients who underwent CABG with no history of prior PCI (Group I) and those with a history of PCI (Group II). The data are presented as the number (%), mean (SD), or median (Q1-Q3)

	Group I (n=50)	Group II (n=50)	P value
Ventilation time (h)			
Range	2 – 21	2 – 26	0.150
Median (IQR)	9 (5 – 13.75)	10 (5 – 19)	
IABP support	1 (2.0%)	7 (14.0%)	0.027
Inotropes	5 (10.0%)	13 (26.0%)	0.037
ICU stay (d)			
Range	1 – 3	1 – 4	<0.001
Median (IQR)	1 (1 – 2)	2 (2 – 3)	
Hospital stay (d)			
Range	7 – 13	6 – 12	<0.001
Median (IQR)	8 (7 – 9)	10 (9 – 11)	

IABP: intra-aortic balloon pump, ICU: intensive care unit, CABG: coronary artery bypass grafting, PCI: percutaneous coronary intervention

Postoperative data

The mean ventilation time (h) was 9 (5–13.75) days for Group I and 10 (5–19) days for Group II, while the mean length of ICU stay was 1 (1–2) day for Group I and 2 (2–3) days for Group II (p<0.001). The length of hospital stay was 8 (7–9) days for Group I and 10 (9–11) days for Group II (p<0.001). There was a statistically significant difference in the use of intra-aortic balloon pump (IABP) support and inotropes (p= 0.027 and 0.037, respectively) (Table 3).

There were statistically significant differences between the studied groups in terms of major adverse cardiovascular events (MACE) (higher in the PCI group, p=0.046), improvement in wall motion abnormalities (higher in the non-PCI group, p=0.007), and postoperative normal EF (higher in the non-PCI group, p=0.032). There was no significant difference in in-hospital mortality between the two groups (Table 4).

Table 4: Comparison of postoperative complications between diabetic patients who underwent CABG with no history of prior PCI (Group I) and those with a history of PCI (Group II). The data are presented as the number (%), mean (SD), or median (Q1-Q3).

	Group I (n=50)	Group II (n=50)	P value
MACE	2 (4.0%)	8 (16.0%)	0.046
Mortality	0 (0.0%)	3 (6.0%)	0.079
Other postoperative complications			
Supraventricular arrhythmia	4 (8.0%)	9 (18.0%)	0.137
Ventricular arrhythmia	1 (2.0%)	1 (2.0%)	1.0
Renal failure (dialysis)	7 (14.0%)	3 (6.0%)	0.182
Stroke	1 (2.0%)	2 (4.0%)	0.558
Re-exploration for bleeding	0 (0.0%)	4 (8.0%)	0.041
CPR	1 (2.0%)	1 (2.0%)	1.0
Wound infection	0 (0.0%)	5 (10.0%)	0.022
Analysis of postoperative echo			
Improvement of dimension	44 (88.0%)	37 (74.0%)	0.074
Improvement of EF	43 (86.0%)	35 (70.0%)	0.053
Improvement of SWMA	48 (96.0%)	39 (78.0%)	0.007
Postoperative normal EF	39 (78.0%)	29 (58.0%)	0.032

MACE: major adverse cardiac events, SWMA: segmental wall motion abnormalities, EF: ejection fraction, CPR: cardiopulmonary resuscitation

Table 5: Logistic regression analysis of variables associated with all-cause in-hospital MACE

	Exp(B) (CI 95%)	P value
Age (y)	2.051 (1.315 – 3.198)	0.002
Sex	0.389 (0.046 – 3.256)	0.384
Obesity	0.375 (0.075 – 1.868)	0.231
LVEF (%)	0.923 (0.865 – 0.985)	0.016
No peripheral vascular disease	0.071 (0.014 – 0.364)	0.001
COPD	0.429 (0.110 – 1.669)	0.222
Hyperlipidemia	1.055 (0.253 – 4.396)	0.941
Angina class I-II	0.025 (0.005 – 0.128)	<0.001
No renal disease	0.086 (0.020 – 0.370)	0.001
Previous PCI	4.571 (0.919 – 22.730)	0.063

PCI: percutaneous coronary intervention, LVEF: left ventricular ejection fraction, COPD: chronic obstructive pulmonary disease

Age, LVEF, peripheral vascular disease, angina class III-IV, and renal disease status were significantly associated with all-cause in-hospital MACE. (Table 5)

Discussion

When treating multivessel coronary artery disease, PCI is usually the first line of treatment before CABG is performed [8]. PCI and CABG are two well-recognized invasive treatment options for multivessel disease patients. Patients may require additional PCI or CABG following a successful revascularization procedure for coronary artery disease [9, 10]. When undergoing CABG, patients who have previously had PCI exhibit more severe symptoms and a stronger sense of urgency. Furthermore, a separate risk factor for in-hospital mortality and worse outcomes after CABG is prior PCI [11]. Patients who underwent PCI before CABG had greater rates of morbidity, death, and need for reoperation, according to research by Eifert's Group [12]. Abdulwahab and Ibrahim [13] claimed that prior PCI is an independent risk factor for in-hospital mortality and a worse outcome after CABG in patients with advanced symptoms and greater urgency. Patients who had previous PCI before CABG had higher rates of morbidity, mortality, and reoperation than did the other patients according to Eifert's group. In our study, individual morbidities, reopening for bleeding, and MACEs were significantly greater in Group II. However, there was no difference in the in-hospital mortality rate between the two groups.

In our study, there was no significant difference in the mean age between the two groups. However, the studies by Eifert et al. [12] and Van den Brule et al. [14] showed significant differences regarding the age of both groups. In contrast to the findings of other significant studies, the frequency of diabetes mellitus was the same in both groups, ruling out its impact on surgical outcomes in this study [15]. The number of patients who underwent unplanned CABG was greater in the PCI group than in the non-PCI group, possibly because of this group's ability to prevent the progression of chest pain to myocardial infarction. According to a previous study [12], patients who had prior PCI before CABG had greater rates of morbidity, death, and reoperation. The non-PCI group had more successfully grafted vessels because more vessels in the PCI group could not be grafted.

Furthermore, because there were more grafted vessels in the non-PCI group, there was a noticeably greater level of total revascularization in this group. Regarding the nongraftable vessels of the PCI group, the cause is most likely the less common finding of atherosclerosis spreading in previously diseased vessels that were not treated or the more common finding of poststent thrombosis propagation leading to complete vessel occlusion [13]. According to Thielmann et al. [16] and Eifert et al. [12], there was no statistically significant difference in the number of CPB procedures between the two groups. Van den Brule et al. [14], in contrast, noted that the duration of CPB was shorter in the PCI group than in the non-PCI group. In our study, the mean CPB time was 108.56 ± 34.53 minutes for Group I and 127.4 ± 35.93 minutes for Group II (p=0.009). In comparison, the aortic cross-clamp time was 75.68 ± 19.94 minutes for Group I and 75.12 ± 23.02 minutes for Group II. Group I had a greater mean number of grafts.

Heilmann et al. [17] reported that there was no difference in IABP use between the two groups, although other studies have shown that the PCI community (Chocron's Group) uses IABP more frequently [18]. Our study showed a significant difference in IABP and inotropic support, which were used more often in the PCI group. Regarding hospital stay, Group I had a shorter duration than Group II. Thielmann et al. [16] reported that even though both groups had the same hospital stay, the ICU stay was longer in the PCI group. However, Van den Brule et al. [14] and Eifert et al. [12] found no difference regarding either ICU or hospital stays.

Limitations

The small number of patients limits the study, and the possibility of underlying bias resulting from patient selection for both groups and the variables influencing surgeons' choices of conduits or grafts are the main limitations of our research.

Conclusion

A previous PCI could increase post-CABG morbidity and MACEs. However, no significant difference in postoperative mortality rates was found between patients who underwent prior PCI and those who did not.

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