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Impact of Previous Percutaneous Coronary Interventions on Early Outcomes of Coronary Artery Bypass Surgery in Patients Undergoing Surgery within 12 Months after Coronary Stent Implantation

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ABSTRACT

Background: Coronary artery disease (CAD) is presently the foremost cause of mortality globally and is anticipated to rise in the near future. Coronary artery bypass grafting (CABG) and percutaneous coronary interventions (PCIs) serve as alternate revascularization strategies for individuals with multi-vessel CAD.

Objective: To investigate whether previous history of PCI will affect morbidity and mortality outcomes in patients undergoing subsequent CABG or not, particularly if CABG was done within the first year after PCI.

Patients and methods: Over a six-month period, 100 patients with multi-vessel CAD who underwent isolated on-pump CABG in Nasser National Institute, Beni-Suef University, and Fayoum University. Patients were excluded if they were undergoing off pump CABG, combined CABG with other procedures, redo CABG, had poor myocardial contractility and patients who had severe preoperative comorbidities. Mortality and morbidity outcomes were analyzed and included 30-day mortality, length of hospital stay, postoperative reopening for bleeding, perioperative myocardial infarction (MI), and prolonged ventilation and arrhythmias. **Results:** Total number of grafts in group A was higher than that of group B (3.16 ± 0.841 versus 2.64 ± 0.898 respectively), which was statistically significant (P value 0.003). The mean time of cardiopulmonary bypass (CPB) and aortic cross clamp time (ACC) were relatively higher in group B (87.6 ± 32.84 and 52.98 ±19 respectively) than in group A (87.38 ±27.29 and 50.38 ±19.70 respectively) despite lesser number of total grafts in group B, which may denote poor targets in this group. Total morbidity including; length of hospital stay, postoperative reopening for bleeding, perioperative MI, prolonged ventilation and arrhythmias were higher in group B and it was statistically significant (P value 0.009). **Conclusion:** Prior PCI may adversely affect the outcomes of later CABG in terms of morbidity and mortality if performed within one year before CABG.

Keywords: CABG, PCI, CAD.

INTRODUCTION

While CABG is still the best option for treating patients with multivessel CAD, left main CAD, or patients with complex calcified vessels that are not suited for stenting. PCI is the favored choice for treating single or double vessel CAD as well as acute coronary syndrome [1]. Recently, there has been an increase in the number of patients referred to CABG after receiving prior PCI, particularly in cases with multi-vessel CAD where CABG explicitly yields better long-term results [2,3]. It is currently unknown how patients undergoing repeat CABG may fare clinically as a result of prior PCI [1]. Numerous investigations have examined the impact of antecedent PCI on the morbidity and mortality consequences of subsequent CABG [3-7].

In our study we wanted to investigate whether previous history of PCI would affect morbidity and mortality outcomes in patients undergoing subsequent CABG or not, particularly if CABG was done within the first year after PCI.

PATIENTS AND METHODS

Over a six-month period, 100 patients who underwent isolated on-pump CABG in Nasser National Institute, Beni-Suef University, and Fayoum University were collected and subdivided into two groups; group (A) that included 50 patients with no previous stent (Non-stent group) and Group (B) that included 50 patients with previous stent (Stent group), in which the interval between stenting and CABG was less than one year, to investigate the impact of previous PCI on CABG outcomes in multi-vessel CAD patients when CABG was performed within 1 year post-stenting.

Inclusion criteria: Patients with multi-vessel CAD undergoing isolated on-pump CABG.

Exclusion criteria: Patients receiving off-pump CABG, combined CABG with other procedures, redo CABG, poor myocardial contractility (Ejection fraction below 30%), and patients with severe preoperative comorbidities (Hepatic, renal, pulmonary, etc.).

Surgical technique:

a) Surgical Approach:

In every case, a median sternotomy was used for surgery. Both groups' incisions and closure methods were identical. Under general anaesthesia, on-pump CABG was started with aortic cannulation and double-stage venous cannula. Systemic heparinization by giving intravenous heparin sulphate (300 IU/kg) was achieved. We proceeded for myocardial protection using ante-grade (warm or cold) blood cardioplegia solution after starting the CPB and clamping of the ascending aorta. All distal coronary anastomoses were completed with a fine polypropylene suture (8-0 or 7-0). Proximal anastomoses to the aorta were done using continuous 6/0 polypropylene sutures. After successful

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weaning from CPB, protamine sulphate was given to reverse the action of heparin. The sternum was closed after confirming surgical and medical hemostasis, and patients were admitted to the postoperative ICU where they were mechanically ventilated and intubated.

b) Operative and postoperative care and monitoring:

ACC time and CPB time, number of grafts, need for inotropes, and use of intra-aortic balloon pump (IABP) were registered. In the ICU, patients were monitored by electrocardiogram (ECG), pulse oximetry and invasive arterial pressure. After weaning from mechanical ventilation and any inotropic support, patients were transferred to the ward for completion of wound care and medical treatment. Postoperative echocardiography (Echo) was done before hospital discharge to monitor postoperative ejection fraction (EF) and any postoperative pericardial collection. Patients were discharged from hospital when they were hemodynamically stable, free from any septic condition, had stable sternum and clean wounds and having clear chest and cardiovascular examinations.

c) Outcome measures and definitions:

We defined 30-day mortality as any deaths occurred within the first 30 days of surgery. Morbidity outcomes included length of hospital stay in days, which indicated the time between surgery and hospital discharge, any early postoperative reopening for bleeding, perioperative myocardial infarction (MI), which was described as the existence of myocardial ischaemia symptoms, ECG changes (New ST elevation of >2 mm in neighboring chest leads and >1 mm in adjacent limb leads), and elevated cardiac enzymes (troponin + ve qualitative) after 12 hours of surgery, prolonged ventilation (>24 hours postoperatively) and arrhythmias (Atrial fibrillation (AF), supraventricular tachycardia (SVT), and cardiac arrest).

Sampling method:

A good sample size was applied; one hundred patients. The Medcalc 19 program was used to examine this number of instances, with the following settings: alpha error of 5%, 95% confidence level, and 80% power sample. **Shahian *et al.*** [8] described equations.

Ethical approval:

The Ethical Committee of Faculty of Medicine, Nasser National Institute, Beni-Suef University and Fayoum University approved the study protocol in its session (111) on 15/10/2023 [Ethical Approval No.: R 500]. Each patient gave written, informed consent before undergoing the procedure. The study adhered to the Helsinki Declaration throughout its execution.

Statistical analysis

Version 23.0 of SPSS for Windows was used to gather and analyze patient data. Quantitative data were presented as mean and standard deviation (SD). To evaluate the data distribution, the Kolmogorov-Smirnov test was used. Quantitative data were compared by independent t-test or Mann-Whitney test. Qualitative data were presented as frequency and percentage and were compared by X^2-test. Significant P-values were those less than 0.05.

RESULTS

No statistically significant differences in patient characteristics were noted. Echocardiography was done usually 3 months or less preoperatively and showed that mean LVEF and LVED in group A were insignificantly less than that of group B. Fourteen patients from group A were affected by septal akinesia versus sixteen patients from group B, which was statistically insignificant. Also, there was no statistical difference in both groups concerning affected coronary arteries in cardiac catheterization (Table 1).

Table (1): Patient characteristics in CABG patients without previous PCI and with previous PCI:

	Group (A) CABG Only (Non-stent group)	Group (B) CABG + Previous PCI (Stent group)	P Value
Age (mean ± SD):	54.21 ± 6.22	54.23 ± 8.89	0.998
Sex:			
Male	41 (82%)	38 (76%)	0.461
Female	9 (18%)	12 (24%)	
Diabetics:	21 (42%)	16 (32%)	0.300
Hypertensives:	30 (60%)	32 (64%)	0.680
Preoperative echo:			
LVEF (mean ± SD):	54.54 ± 11.45	54.96 ± 11.08	0.853
LVED (mean ± SD):	5.29 ± 1.20	5.33 ± 1.08	0.861
Areas of septal hypokinesia:	36 (72%)	34 (68%)	0.663
Areas of septal akinesia:	14 (28%)	16 (32%)	0.663
Cardiac Catheterization:			
LAD	50 (100%)	50 (100%)	1
Diagonal	38 (76%)	35 (70%)	0.499
OM	36 (72%)	33 (66%)	0.517
RCA and/or PDA	38 (76%)	33 (66%)	0.271

Standard deviation (SD), left ventricular ejection fraction (LVEF), left ventricular end diastolic diameter (LVED), left anterior descending artery (LAD), obtuse marginal artery (OM), right coronary artery (RCA), posterior descending artery (PDA).

Operative data and postoperative outcomes for the two groups are shown in table (2). In all patients in both groups pedicled left internal mammary artery (LIMA) was used for anastomosis to the left LAD and saphenous vein graft (SVG) for other targets.

Total number of grafts in group A was statistically significantly higher than that of group B and it means that patients with previous PCI received lesser number of coronary artery grafts. Mean time of CPB and ACC were relatively higher in group B than in group A despite lesser number of total grafts in group B, which may denote poor targets in this group, but this was statistically insignificant.

According to postoperative outcomes, the need for early inotropic support (during first 24 hours) was statistically significantly higher in group B. Cases suffered from acute MI were statistically significantly higher among CABG patients with previous PCI (group B). The mean ventilation hours was statistically significantly higher among group B patients.

Incidence of arrhythmias was nearly the same in the two groups. Patients with previous PCI (group B) received more blood transfusion with statistically significant high incidence in the rate of reopening for bleeding. Overall hospital morbidity was also statistically significantly higher among CABG patients with previous PCI (group B).

The mean length of hospital stay was statistically significantly higher for CABG patients with previous PCI (group B). Total number of mortality cases was slightly higher between CABG patients with previous PCI (group B).

Table (2): Operative and postoperative data in CABG patients with no previous PCI and with previous PCI:

	Group (A) **CABG Only** **(Non-stent group)**	**Group (B)** **CABG + Previous PCI** **(Stent group)**	**P Value**
Total distal coronary anastomosis, n (mean ± SD):	3.16 ± 0.841	2.64 ± 0.898	0.003*
CPB time, min (mean ± SD):	87.38 ±27.29	87.6 ± 32.84	0.971
ACC time, min (mean ± SD):	50.38 ±19.70	52.98 ±19	0.503
Early inotropes needed	6 (12%)	18 (36%)	0.005*
Use of IABP	2 (4%)	7 (14%)	0.081
Perioperative MI, n (%)	2 (4%)	8 (16%)	0.046*
Mean ventilation hours (mean ± SD):	12.12 ± 9.50	29.82 ± 56.94	0.033*
Incidence of arrhythmias (A.F, SVT) n (%)	7 (14%)	11 (22%)	0.298
Reoperation for bleeding, n (%)	3 (6%)	10 (20%)	0.037*
Total hospital morbidity, n (%)	9 (18%)	21 (42%)	0.009*
Total length of hospital stay in days (mean ± SD):	11.5 ± 10.19	18.38 ± 21.86	0.046*
Total mortality, n (%)	1 (2%)	4 (8%)	0.169

Cardiopulmonary bypass time (CPB), Aortic cross-clamp time (ACC), Intra-aortic balloon pump (IABP), Myocardial infarction (MI), Atrial fibrillation (AF), Supraventricular tachycardia (SVT). *: Significant

DISCUSSION

There is growing evidence these days that a prior PCI has a negative impact on the result of a subsequent CABG. In contemporary cardiac surgical outcome prediction and risk classification models, prior coronary stenting may be expected as a risk factor. Up until now, the only risk model that took into account prior PCI done within 6 hours of surgery was the Society of Thoracic Surgeons (STS) risk model [8,9].

In their work, **Bonaros *et al.*** [10] assessed how well-suited standard risk classification models are for predicting the perioperative outcomes of coronary stenting in patients undergoing cardiac surgery. The non-stent group had a higher 30-day mortality rate according to statistical analysis (area under the curve: 0.875 vs. 0.552 in the stent group). In the non-stent group (95% CI: 0.806–0.934; p = 0.0004), logistic Euro SCORE predicted 30-day mortality; in contrast, in the stent group (95% CI: 0.301–0.765; p = 0.8), it did not. According to the authors, risk assessment for surgical patients who have had prior PCI needs to be improved, and the Euro SCORE and the STS model were found to be unreliable in predicting perioperative mortality following CABG in patients with a history of elective percutaneous coronary stenting. In the context of current knowledge regarding the relationship between coronary stenting and surgery, patients will have more precise information about the severity of their disease and the precise risk of surgical intervention if "previous PCI" is taken into account as an additional risk factor in the risk stratification model.

In our study, concerning the demographic data, we tried to have similar results in both groups by eliminating higher and lower age groups, which has also another value, which is avoidance of other comorbidities, so we have no significant differences in demographic data between the two groups.

Our study revealed that total number of grafts in group A (140 with mean 3.16 ± 0.841) were higher than that of group B (132 with mean 2.64 ± 0.898), which was statistically significant (P value 0.003). This is similar to the results from **Lisboa *et al.*** [11] who showed that the mean number of grafted coronary arteries was smaller in patients with prior PCI (3.0 vs. 3.2 – p=0.446), however the difference was not statistically significant.

Our study also showed that mean time of CPB and ACC were relatively higher in group B (87.6 ± 32.84 and 52.98 ±19 respectively) than in group A (87.38 ±27.29 and 50.38 ±19.70 respectively) despite that group B had fewer total grafts, which may indicate that these goals were not very good, but without statistical significance. These results are similar to that of **Lisboa *et al.*** [11], which showed prolonged ACC time (76.1 vs. 74.8 minutes, p=0.673) and prolonged CPB time (90.7 vs 85.3 minutes, p=0.584), also without statistical significance. Despite a longer time was taken to dissect on the more distal coronary artery branches, fewer distal coronary arteries in group B were grafted, 2.64 versus 3.16 in group A, due to technical difficulty of implanting on thinner distal coronary branches. Also, more time was consumed to ensure adequate hemostasis after graft implantation.

In our study, 6 cases in group A (12%) needed early inotropes and only 2 needed to continue on support due to low cardiac output, while 18 (36%) patients in group B needed early inotropes and only 8 of them needed to continue on inotropes after 24 hours due to acute MI. This was statistically significant (P value 0.005) and similar to the results from **Negargar *et al.*** [12] study, which showed higher use of early inotropes among CABG patients with previous PCI (P value was 0.0003). Use of IABP was higher in group B, but it was statistically insignificant (P value 0.081). This is similar to the results from **Negargar *et al.*** [12] study, which showed higher use of IABP in cases with previous stent without statistical significance (P value was 0.17). Number of cases suffered from perioperative MI was statistically significantly higher among group B patients (p value 0.046). We believe that in patients with prior PCI (group B) as opposed to group A, the more distal implantation of the grafted conduits was the cause of the elevated risk of perioperative MI after CABG and also pathological changes following PCI may lead to early graft closure after CABG. This is similar to the results from **Negargar *et al.*** [12] study, which showed that those with stents had a considerably greater mean blood level of Troponin T 12 hours after surgery than those without stents.

The last issue that was very challenging is that we were unable to stop antiplatelet therapy before surgery due to risk of stent thrombosis in patients with previous PCI (group B) and consequently this led to higher incidence in the rate of reopening for bleeding in this group, which was statistically significant (P value 0.037). It may be also due relative higher cross clamp time and total bypass time, which increase coagulopathy. These results are similar to that of **Negargar *et al.*** [12] study, which showed significant bleeding among CABG patients with previous PCI (15.1% vs. 4.3%, p=0.001).

Total hospital morbidity including length of hospital stay, prolonged mechanical ventilation, perioperative MI, arrhythmias and bleeding needing reopening were statistically significantly higher (P value 0.009) in group B (CABG with previous PCI). These results are similar to that of **Negargar *et al.*** [12]

study, which showed significant overall morbidity among CABG patients with previous PCI (p<0.001).

Mortality from group A was one patient (EF preoperative was 37%, age 65y, with three vessel disease, underwent CABG x 3 grafts - LIMA to LAD, SVG to RCA and OM), patient needed on-lay patch by mammary to LAD, cross clamp time was 70 minutes, while total bypass time was 110 minutes. Postoperatively that patient suffered from acute MI with introduction of IABP and then he died after 3 days due to low cardiac output. Mortality from group B was four patients, two of them died from ventricular fibrillation (VF) as a consequence of acute MI (both have good preoperative EF, IABP were inserted soon after diagnosis of MI), while the other two patients died from complications of bleeding. In-hospital mortality was slightly higher between CABG patients with previous PCI (group B), but without statistical significance (P value 0.169). This is similar to the results from ***Lisboa et al.*** [11] study, which showed that in-hospital mortality was considerably greater in patients who had prior PCI than in individuals who had no prior PCI (9.3% vs. 5.1%, p=0.034).

CONCLUSION

Previous percutaneous coronary artery stenting has a negative effect on the outcomes of subsequent coronary artery bypass surgery especially the higher incidence of morbidity and mortality outcomes, if coronary stenting was done within one year before surgery. History of PCI should be considered as an independent risk factor in patients during preparation for CABG. There should be more studies to investigate more on CABG with previous PCI as this may improve the selection of the best revascularization option for patients.

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