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Hazem G. Bakr
National Heart Institute (NHI), dr_hazem212@hotmail.com

Ibrahim M. Helmi
National Heart Institute (NHI)

Waleed A. Kamel
National Heart Institute (NHI)

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Does the previous stenting affects the outcome of coronary artery bypass grafting in patients with multivessel disease

Hazem G. Bakr[a], Ibrahim M. Helmi[b], Waleed A. Kamel[a]

Departments of [a]Cardio-Thoracic Surgery, [b]Radiology, National Heart Institute (NHI), Giza, Egypt

Abstract

Background

During the past decade, the number of percutaneous coronary interventions (PCI) performed before coronary artery bypass grafting (CABG) has risen significantly. Patients with more serious coronary pathology are referred for CABG, which can affect the postoperative outcome.

Patients and methods

Outcomes of 60 CABG patients, who were recruited in a prospective comparative study, were compared. Group A (n = 30) underwent primary CABG and group B (n = 30), had prior PCI before CABG.

Results

Total morbidity was substantially higher in the second group than in the first, with six patients in group A (nonstent group) and 19 patients in group B being affected (stent group). Inotropes and intraaortic balloon pump were used more in the previous PCI community than in group A. Group B had a longer ICU stay (50.45 ± 33.49 h in group A vs. 79.56 ± 60.44 h in group B).

Conclusion

Previous PCI can have a detrimental effect on the morbidity outcome of the subsequent CABG. However, postoperative mortality has not been affected significantly. Thus, percutaneous coronary revascularization should be carefully weighed against the increased risk of CABG afterward. The guidelines for intervention should be strictly followed, particularly in patients with complex coronary lesions who are more likely to be referred for CABG.

Keywords: Coronary artery bypass grafting, percutaneous coronary intervention, previous stenting

Introduction

Despite all clinical evidence and treatment recommendations for chronic coronary artery disease showing the benefits of coronary artery bypass grafting (CABG), particularly in patients with multivessel disease, percutaneous coronary intervention (PCI) with stents has grown at an exponential rate. It has been around since 1977, when Gruntzig first launched it. The indication for PCI has grown as a result of technical developments and experience gained over time, and procedures in multivessel coronary disease have become more common because they are less invasive and more appealing to the patients. Approximately 30% of the patients with multivessel disease who were managed with bare metal stents will require reintervention within a few year [1].

Patients with coronary artery disease and a class I indication for CABG are often referred to PCI as a first-line treatment option in this so-called 'stent age' before being persuaded to undergo surgery. Several studies comparing the outcomes of CABG and PCI as the primary treatment for coronary artery disease have been published. Aside from the rise in age and comorbidity, the current population of CABG patients includes a growing number of patients who have had a previous active PCI [2].

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Correspondence to: Dr. Hazem G. Bakr, M.D,
Cardio-surgery Department, national Heart Institute, address: 12 elnadi elryadi st, nassr eldeen, elharram, Giza, Egypt.
tel: +201000980986
E-mail: dr_hazem212@hotmail.com

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The relative values of coronary artery bypass surgery and PCI are required to be reassessed as a result of technical developments and improvements in clinical practice [3]. The SYNTAX multicenter prospective randomized study aims to provide evidence for determining the best care choice for patients seen by surgeons and interventional cardiologists in their everyday practice [4].

These findings clearly showed that there was no difference in mortality and nonfatal myocardial infarction between the two therapeutic modalities, but patients treated with stenting, whether bare metal stent or drug-eluting stent, needed further revascularization procedures owing to restenosis [5].

The rising list of angioplasty indications has already had a substantial effect on the practice of coronary revascularization. Owing to the incidence or possibility of stent restenosis, many patients are still referred for surgery. PCI, which occurs with an average incidence of 20–40% in the last decade, has undergone major improvements in the procedures used to achieve revascularization and in patient selection [6].

Patients who have had a prior PCI are thought to be at a higher risk for CABG. Only a few studies are available, and they are contradictory: some authors claim that initial PCI may complicate the procedure and increase postoperative morbidity and mortality [7–9,20], whereas others claim that there is no difference in postoperative morbidity and mortality [1,2,5].

Aim

The aim of this study is to study the prognostic effect of the previous stenting on the outcome of CABG in patients with multivessels disease.

Patients and methods

Ethical committee approved the study (NHI-1-10-02-2019).

A prospective comparative study was conducted that included 60 patients who underwent CABG at the National Heart Institute.

The study was conducted between March 2019 and January 2021.

To address the prognostic effect of prior stenting on CABG outcome in patients with multivessel disease, patients were divided into two groups:

(1) Group A: 30 patients had CABG with no previous stent (nonstent group).
(2) Group B: 30 patients had CABG with previous stent (stent group).

Inclusion criteria

The research included patients who had ischemic heart disease and were scheduled for coronary artery bypass surgery. The research included patients who had diabetes, hypertension, hypercholesterolemia, and a healthy family history as risk factors.

Exclusion criteria

The following were the exclusion criteria:

(1) Patients with single-vessel disease, as the study enrolled only multivessels disease patients.
(2) Combined CABG with other procedure.
(3) Emergency CABG patients after PCI due to dissection or tamponade.
(4) Redo CABG.
(5) Carotid artery stenosis with CABG.
(6) Preoperative comorbidities (hepatic, renal, pulmonary, etc.)

Preoperative evaluation

(1) Informed consent, history taking, and clinical examination were done.
(2) Routine investigations included the following:
    (a) Routine perioperative laboratory investigations, ECG, radiological examination, echocardiography, preoperative TEE, and coronary angiography.

Operative evaluation

(1) Surgical approach.

General principles

In all cases, surgical access to the heart was gained by a median sternotomy. Both parties used the same incisions and closing methods. For all distal anastomoses, fine monofilament polypropylene sutures (8–0 or 7–0) were used. For venous and arterial anastomoses to the aorta, proximal anastomosis was performed with fine monofilament polypropylene sutures (6–0).

The conventional procedure of CABG was done.

Data recorded were as follows:

(1) Operative time.
(2) Time of aortic cross-clamp and extracorporeal circulation.
(3) Number of grafts, and arterial or venous grafts.
(4) Inotropes and use of dilators.
(5) Intraaortic balloon pump (IABP) need.

Postoperative data

(1) ICU stay, ventilation, inotropic agents when indicated, and postoperative echocardiography were recorded.

Judgment criteria

(1) The main judgment criteria were as follows:
    (a) Vital signs (blood pressure, temperature, pulse, urine output, and oxygen saturation).
    (b) ECG first day, 48 h, and end of the first week.
    (c) Echocardiography.

The postoperative echocardiography

An echocardiography was done before discharge to monitor the following:

(1) Left ventricular end-diastolic dimension (LVEDD) and ledft ventricular end-systolic dimension (LVESD).
(2) Postoperative Ejection Fraction (EF).

Results

Demographic data

Table 1.

Preoperative data analysis

Tables 2 and 3.

Operative analysis

The mean number of grafts was significantly higher in group A (nonstent group) (Tables 4-6).

Postoperative data analysis

Inotropes and IABP were found to be used more with the previous PCI group rather than group A (nonstent group) (Tables 7-9).

Hospital stay was statistically nonsignificant, whereas the mean ICU stay was longer for group B, with a significant *P* value. A shown in Table 10, total morbidity was substantially higher in the second group than in the first, with six patients in group A and 19 patients in group B being affected. Reopening cases were highly significant in group B (stent group) which were seven patients, while in group A (non-stent group) were only two patients. The incidence of superficial wound infection (two patients vs. eight patients) was found to be statistically higher in group B than in group A (Table 11).

There was no significant difference in in-hospital mortality rate between the two groups (Table 12).

Table 1: Age and sex of both groups

	Group I	Group II	*P*
	Mean±SD	Mean±SD	
Age (years)	53.88±7.80	51.36±8.05	NS
Male	23	24	NS
Females	7	6	NS

NS, nonsignificant. *P* less than 0.05 is considered significant.

Table 2: Preoperative echocardiography in both groups

Pre-echocardiography	Group A	Group B	*P*
	Mean±SD	Mean±SD	
EF%	55.82±11.35	53.64±13.77	NS
EDD	5.5±0.53	5.6±0.69	NS
ESD	3.55±0.67	3.75±0.66	NS

EDD, end diastolic dimension; ESD, end systolic dimension; EF%, ejection fraction %; NS, nonsignificant. *P* less than 0.05 is considered significant.

Table 3: Number of diseased vessels in both groups

Number of diseased vessels	Group A	Group B	*P*
	Mean±SD	Mean±SD	
	3.5±0.41	3.3±0.43	NS

NS, nonsignificant. *P* less than 0.05 is considered significant.

Table 4: Mean number of grafts in both groups

Mean number of grafts	Group A	Group B	*P*
	Mean±SD	Mean±SD	
	3.41±0.65	2.39±0.57	0.00364*

*Statistically significant. *P* less than 0.05 is considered significant.

Table 5: Type of the conduits used

Type of conduits	Group A	Group B
LIMA	30	30
SVG	50	35
Radial A.	3	2

A, artery; LIMA, left internal mammary artery; SVG: saphenous venous graft.

Discussion

PCI is most commonly used as the initial revascularization technique in multivessel disease in the new period of stent use before patients are referred to CABG [10].

CABG and PCI have also been used to treat patients with coronary artery disease for a long time. Several randomized observational trials have compared the interventional effectiveness and relative benefits. Patients who have active myocardial revascularization may need more invasive cardiological or surgical intervention in the future [11].

In the SYNTAX analysis, PCI had significantly higher 3-year MACCE rates than CABG; this was primarily owing to a higher incidence of the need for repeat revascularization in the PCI arm, as well as a higher number of MI among PCI patients at 3 years, particularly between years 1 and 2 and years 2 and 3 [4].

Within 30 days of discharge, a large percentage of PCI patients are readmitted, and readmission rates differed greatly between hospitals. Readmissions within 30 days of a PCI procedure were related to a higher 30-day mortality rate, with more than a quarter of these readmissions resulting in a repeat revascularization procedure [9].

Chocron *et al*. [12] and Thielmann *et al*. [13] have suggested that PCI might have been suboptimal because DES was used less often than BMS, which may have a lower restenosis rate. Nonetheless, as several meta-analyses have consistently shown that although DES reduces the risk of restenosis in low-risk coronary lesions, they do not reduce the risk of mortality or subsequent myocardial infarction; it is unlikely that they will improve outcomes following CABG. This is in addition to the fact that there are no research studies on moderate and high-risk coronary artery lesions [13].

Abdulwahab and Ibrahim [7] 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 a higher rate of morbidity, mortality, and reoperation, according to Eifert's community. Before coronary angioplasty, a percutaneous coronary operation was

Table 6: Difference of total operative time, aortic cross-clamp, and cardiopulmonary bypass time in both groups

	Group A	Group B	*P*
	Mean±SD	Mean±SD	
Total op. (min)	171.8±35.4	204.45±41.65	0.0215*
ACC (min)	78.2±12.46	85.58±15.54	0.035*
CPB (min)	115.7±18.31	118.12±16.14	NS

ACC, aortic cross-clamp; CPB, cardiopulmonary bypass; NS, nonsignificant; op., operative. *Statistically significant. *P* less than 0.05 is considered significant.

Table 7: Inotropic need and intraaortic balloon pump use in both groups

	Group A	Group B	*P*
Inotropes	6	14	0.023*
IABP	2	9	0.035*

IABP, intraaortic balloon pump; NS, nonsignificant. *Statistically significant. *P* less than 0.05 is considered significant.

Table 8: Mean ventilation hours in both groups

MVH (h)	Group A	Group B	*P*
	Mean±SD	Mean±SD	
	17.22±19.89	23.44±23.98	NS

MVH, mean ventilation hours; NS, nonsignificant. *P* less than 0.05 is considered significant.

Table 9: ICU stay and hospital stay in both groups

	Group A	Group B	*P*
	Mean±SD	Mean±SD	
ICU stay (h)	50.45±33.49	79.56±60.44	0.004*
Hospital stay (days)	12.06±4.66	11.73±3.79	NS

NS, nonsignificant. *Statistically significant. *P* less than 0.05 is considered significant.

Table 10: Morbidity in both groups

	Group A	Group B	*P*
Total morbidity	6	19	0.015*
Reopening	2	7	0.047*
Superficial wound infection	2	8	0.039*
Post operative MI	1	2	NS
AF	1	1	NS
Respiratory	0	1	NS

AF, atrial fibrillation; NS, nonsignificant. *Statistically significant. *P* less than 0.05 is considered significant.

performed. In patients with diabetes and triple-vessel disease, artery bypass grafting raises the risk of in-hospital mortality and significant adverse cardiac events [8]. Chocron *et al*. [12] looked at the patients' preoperative EF and found that those with a left ventricular ejection fraction of less than 40% and a history of PCI before surgery had a worse post-CABG outcome than those with a higher EF those with no prior PCI. Van den Brule *et al*. [14], on the contrary, stated that effective PCI has no effect on the short-term and mid-term outcomes of subsequent CABG. This prompted us to investigate the effects of previous PCI on the outcome of CABG in patients with multivessel disease, in order to decide if the dictum that patients who have had previous PCI can safely undergo a subsequent CABG is valid or not.

In our study, there was no difference in mean age of both groups. However, the studies by Eifert *et al*. [8] and Van den Brule *et al*. [14] showed differences regarding the age of both groups.

The preoperative echocardiography showed that there were no variations in preoperative end systolic dimension, end diastolic dimension, or EF percent in our sample. Similarly, Eifert *et al*. [8] and Kanemitsu *et al*. [15] found no difference in the EF percent between PCI and non-PCI groups.

The existence of a previous stent has no influence on the choice of the surgical technique. This research, as well as Chocron *et al*. [12] study, showed that off-pump coronary artery bypass (OPCAB) was used similarly in both classes. All patients in the studies by Eifert *et al*. [8] and Van den Brule *et al*. [14] were put on cardiopulmonary bypass (CPB), whereas all patients in the research by Kanemitsu *et al*. [15] were put on OPCAB.

The mean number of grafts in group A (3.41 ± 0.65) was significantly higher than in the PCI group (2.39 ± 0.57) in our analysis. Our findings are consistent with those of Eifert *et al*. [8]. As there are more nongraftable vessels in the PCI group, the number of grafted vessels is higher in the non-PCI group. Total revascularization was also significantly higher in the non-PCI group, which was anticipated owing to the higher number of grafted vessels in this group. Regarding the PCI group's nongraftable vessels, the reason is most likely owing to either poststent thrombosis propagation to fully occlude the vessel, which is more common, or atherosclerosis propagation in previously diseased vessels left untreated (less common) [7]. For the surgeon, this made the anastomosis more difficult and dangerous. [9].

Thielmann *et al*. [13], Eifert *et al*. [8], Mack [16] reported that there was no statistical difference in CPB times between the two groups, but Van den Brule's *et al*. [14] stated that only the PCI group's CPB period was shorter. In our study, despite the higher number of distal anastomoses in group A, there was no statistical difference in the mean CPB period between the two groups (115.7 ± 18.31 min in group A vs. 118.12 ± 16.14 min in group B). However, the mean total operational time (171.8 ± 35.4 min in group A vs. 204.45 ± 41.65 min in group B) and the mean aortic cross-clamp time (78.2 ± 12.46 min in group A vs. 85.58 ± 15.54 min in group B) were both significantly higher in group B than in group A. This may be explained by the fact that group A vessels have had fewer procedures performed on them, such as endarterectomy and/or lay patch anastomoses.

Table 11: Mortality in both groups

Mortality in both groups	Group A	Group B	*P*
	0	1	NS

NS, nonsignificant.

Table 12: Postoperative echocardiography in both groups

Postoperative echocardiograph	Group A	Group B	*P*
	Mean±SD	Mean±SD	
EF%	57.8±8.6	53.64±11.67	NS
EDD (cm)	5.22±0.71	5.3±0.87	NS
ESD (cm)	3.7±0.75	3.64±0.83	NS

EDD, end diastolic dimension; EF%, ejection fraction %; ESD, end systolic dimension; NS, nonsignificant. *P* less than 0.05 is considered significant.

In our study, postoperative inotropes were used more frequently in the previous PCI community than in group A, but IABP use was similar in both groups. The enhanced use of inotropic support can be connected to a lower rate of total revascularization and a higher rate of preoperative MI. Thielmann *et al*. [13] found no difference in IABP use between the two groups, but other studies have found a higher incidence of IABP use in the PCI community (Chocron's group) [12]. The worst CABG results after angioplasty, according to Taggart, may be attributed to coronary endothelial dysfunction induced by stent implantation, which would be exacerbated by the inflammatory and coagulation disorders that arise throughout surgery [17]. Another possibility is that prior stent implantation necessitates the detection of more distant coronary segments with weak outflow in order to perform coronary anastomosis, or that these intracoronary devices may impede collateral coronary flow [18].

Overall morbidity was statistically higher in the second category than in the first, according to our research (6 vs. 19). The explanations for the prior PCI group's higher postoperative morbidity are unknown; however, the PCI group patients were presented for surgery with more advanced symptoms and a greater sense of urgency, as declared by Abdulwahab and Ibrahim [7] and his team. Further morbidity analyses revealed that the PCI group had a higher rate of re-exploration and superficial wound infection. This may be explained by the long-term use of clopidogrel before the surgery (and till the operation in case of emergency operation). Moreover, aspirin was not stopped in the PCI group until the morning of the procedure as a precaution against complete stent occlusion and perioperative MI. [7].

Other authors such as Taggart [17], Chocron *et al*. [12], Abdulwahab and Ibrahim [7] and Thielmann *et al*. [13] claimed that the PCI group had a high rate of morbidity. The findings of Massoudy *et al*. [19] were similar, but they also found that morbidity rises as the number of previous interventions rises. Thielmann *et al*. [13] also noticed a high rate of reopening in PCI group.

Our analysis found that the PCI group had a statistically significant longer ICU stay (50.45 ± 33.49 h in group A vs. 79.56 ± 60.44 h in group B), but the hospital stay was not different. Moreover, Thielmann *et al*. [13] reported that despite the fact that both groups had the same hospital stay, the PCI group's ICU stay was longer. However, regarding both ICU and hospital stays, Van den Brule *et al*. [14] and Eifert *et al*. [8] found no difference. In our study, the difference in ICU stay was owing to differences in morbidity, especially reopening, which lengthened ICU stay.

After the procedure, all of the patients in our study were checked up on. A postoperative echocardiography was performed before discharge. Despite the fact that group A had more grafts done, they were more fully revascularized, had less need for postoperative inotropic support, and had a lower morbidity rate and shorter postoperative ICU stay, there was no statistical difference between the two groups in terms of LV performance postoperatively in the form of mean end systolic dimension (3.7 ± 0.75 vs. 3.64 ± 0.83 cm), mean end diastolic dimension (5.22 ± 0.71 vs. 5.3 ± 0.87 cm), and in postoperative EF% (57.8 ± 8.6 vs. 53.64 ± 11.67). In contrary to our findings, Velicki *et al*. [18] found a substantial difference in postoperative EF between the left and right ventricles. The stented group's ventricular ejection fraction increased more than that in the nonstented group, which may be owing to longer follow-up (18 months).

In terms of in-hospital mortality, our findings go hand in hand with those of Cheng *et al*. [9], as well as Kanemitsu *et al*. [15], suggesting that there was no substantial difference between the two groups. On the controversy, Mack [16], Thielmann *et al*. [13], and Abdulwahab and Ibrahim [7] stated that patients with prior PCI had higher in-hospital mortality owing to the effect of PCI on the coronary arteries as we illustrated before.

Cheng *et al*. [9] revealed that coronary stenting before CABG for multivessel coronary artery disease improved 30-day mortality but had no effect on late survival. Likewise, Eifert *et al*. [8] claimed that in the first 30 days after surgery, the PCI group had a higher mortality rate, which then decreased to a nonsignificant difference between the two groups over the next 5 years. On the contrary, multiple studies have shown that a prior PCI procedure does not raise the risk of postoperative complications after a CABG procedure [1,2,5].

Conclusion and recommendation

(1) A previous PCI may have a negative effect on the outcome of a subsequent CABG in terms of morbidity; however, there was no disparity in the postoperative mortality.
(2) Percutaneous coronary revascularization should be carefully weighed against the increased risk of CABG afterward. The intervention guidelines should be strictly followed, especially in patients with complex coronary lesions who are more likely to be referred for CABG surgery.
(3) Our recommendation is to follow-up the patients for longer period of time to get a precise assessment.

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Conflicts of interest

There are no conflicts of interest.

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