Research Article

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Coronary Stenting versus Bypass Graft Surgery for Management of Left Main Coronary Artery Disease in the Setting of Acute Myocardial Infarction: A Retrospective Cohort Study

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ABSTRACT

Background: *There is a lack of published research that compare stenting versus coronary artery bypass grafting (CABG) for patients with left main coronary artery (LMCA) disease. This research compared the safety and efficacy of stents versus CABG for patients with LMCA disease in the setting of acute myocardial infarction.*

Materials and Methods*: A retrospective chart review was conducted to retrieve the records of LMCA who underwent coronary stenting or CABG. We compared both techniques in terms of major adverse cardiovascular and cerebrovascular events (MACCE) and postoperative complications.*

Results*: Sixty patients were included (30 patients in each group). The incidence of periprocedural mortality was equal between PCI and CABG groups (6.7% versus 10%). Likewise, the overall incidence of periprocedural complications was comparable between both groups (13.3% versus 20%). The incidence of immediate post procedural complications was 20% and 30% in PCI and CABG groups, respectively (p =0.37). Likewise, the rate of immediate post procedural mortality was 3.3% and 6.7%, respectively (p =1.0). Both groups exhibited similar rates of late post procedural complications as well (p =0.25).*

Conclusion*: In conclusion, PCI and CABG had comparable postoperative outcomes in LMCA patients in the setting of acute myocardial infarction. Further randomized controlled trials with larger sample size and longer follow-up period are required to evaluate the safety and efficacy of both techniques in such patients.*

Keywords
Coronary Stenting; Left Main Coronary Artery Disease; Bypass Graft Surgery; Acute Myocardial Infarction.

Introduction
Left main coronary artery (LMCA) stenosis is encountered in nearly 10% of patients undergoing coronary angiography and remains a substantial risk factor for increased mortality and morbidity [1]. In patients with acute myocardial infarction (AMI), especially in the LMCA, cardiogenic shock may affect up to 80%, which is known as LMCA cardiogenic shock syndrome [2]. It was estimated that the mortality rate is 100% with conservative treatment and 89% with surgery in patients with LMCA cardiogenic shock syndrome [3,4]. It was recommended to assign patients with LMCA to coronary artery bypass grafting (CABG), according to the European and American guidelines [5,6].

A growing body of evidence demonstrated that, in specific subset of LMCA patients, percutaneous coronary intervention (PCI) with drug-eluting stent (DES) is an effective alternative interventions, with acceptable postoperative safety profile [7,8].

Previous reports demonstrated that both DES and CABG had comparable incidences of 4-year cardiovascular and cerebrovascular events, and mortality rates in patients with low SYNTAX score [9]. Other reports demonstrated that only patients with minimal to moderate anatomical complexity had satisfactory PCI results [10]. Furthermore, it was noted that DES had more favorable outcomes compared with the first-generation stents used in previous studies [11]. The improvement in the surgical procedures and DES has significantly improved the outcomes of PCI in the setting of LMCA as well [12,13]. The initial use of bare-metal stents had the disadvantage of higher risks of restenosis and sudden deaths; however, with the introduction and advancement of DES was associated with a notable reduction in restenosis and mortality [14].

Recently, many observational studies and clinical trials confirm the benefits of stenting for LMCA disease as compared to CABG [3,4]. Other than a substantial rise in periprocedural MI or stroke in CABG patients, some trials showed that stenting and CABG are comparable in terms of early clinical events of LMCA [15]. Because of this, there is a lack of published research that compare stenting versus CABG for patients with LMCA disease. This research compared the safety and efficacy of stents versus CABG for patients with LMCA disease with low Syntax score in the setting of acute myocardial infarction.

Materials and Methods

The protocol of the study was approved by the Ethical Committee of National Heart institute, Giza, Egypt (IHC00010). The study's objectives and procedures were explained in detail for all eligible patients; only patients who agreed to a signed written informed consent were included. We confirm that none of the study's procedures violated the main principles of the Declaration of Helsinki [16].

Study design and patients

We conducted a retrospective cohort study that recruited patients presenting with AMI to the cardiac intensive care units (CCU) and showed significant LMCA disease on coronary angiography with low Syntax score. Patients with high syntax score were excluded from the study. Eligible patients were recruited to either PCI with stenting or CABG. The recruitment period lasted for one year from January to December 2020. We included adult patients with de novo LMCA and ≥50% target vessel stenosis. The diagnosis of LMCA disease was based on visual detection of ≥50% of LMCA or LMCA equivalent (e.g., the ostium of the left anterior descending artery or the left circumflex), regardless of the presence of stenosis in other vessels. We excluded patients with previous history of CABG or PCI, patients with concomitant valvular or aortic surgery, and/or patients presented with cardiogenic shock.

Study's interventions

Complete medical reports of all eligible patients were made. Patients were subjected to history taking, full clinical examination, routine laboratory investigations, baseline 12-lead electrocardiogram ECG findings., echocardiography, and diagnostic coronary angiography Patients were instructed to take the following pre-procedure medications: aspirin 325 mg, ticagrelor 180 mg (or clopidogrel 600 mg) as a loading dose, and a weight-adjusted unfractionated heparin regimen (bolus of 70 to 100 U/kg). Both techniques were performed according to the local guidelines of the National Heart institute, coronary anatomy, synthax score, and surgeon's decision. The utilization of the on- or off-pump CABG was based on surgeon's decision. Concerning stenting, the routine practice in the institution involves complete coverage of lesions with nearly four mm of stent overlapping at both sides of the lesions, with the use of final kissing balloons inflation after bifurcation stenting (when required). Following the procedure, the patients received the standard regimen for STEMI including lifetime aspirin, ticagrelor (or clopidogrel) for at least six months, B-blockers, nitrates, low molecular weight heparin, angiotensin converting enzyme (ACE) inhibitors, diuretics, and calcium antagonists.

Study's outcomes

The primary endpoint in the present study were major adverse cardiovascular (myocardial infarction, malignant arrythmia, heart failure, death), and cerebrovascular events (ischemic stroke, cerebral hemorrhage). (MACCE), defined as in-hospital allcause death, AMI, or ischemic stroke. Other outcomes include complete heart block, cardiogenic shock, and cardiac arrest.

Statistical analysis

The SPSS (IBM SPSS Statistics for Windows, Version 24.0. Armonk, NY: IBM Corp.) was used for data processing and analysis. The central tendency and variability of the numerical data were presented in the form of mean ± standard deviations (SD) or median with interquartile range (IQR), according to the normality of data distribution. Categorical variables were summarized by frequency counts and percentages. The significance of association between study's interventions and study's outcomes was assessed using ANOVA test and Chi-square test for continuous and categorical data, respectively. P-value <0.05 was regarded as statistically significant.

Results

Thirty patients were included for each group, with a mean age of 57.8 ±8.3 and 56.8 ±10, respectively (p =0.65). Most patients were males (73.3% versus 76.7%, respectively; p =0.76) and smokers (53.3% versus 53.3%, respectively). Both groups were comparable in terms of frequency of hypertension (p =0.75), diabetes (p =0.61), and dyslipidemia (p =0.52). On the other hand, patients who underwent CABG had significantly higher number of affected vessels (two vessels in 80%in CABG versus 36.7% in PCI group, p =0.001), Table 1.

The incidence of periprocedural mortality was equal between PCI and CABG groups (6.7% versus 10%, p=1). Likewise, the overall incidence of periprocedural complications was 13.3% for PCI versus 20% for CABG, p=0.48).

Table 1: Clinical characteristics of both groups.

		PCI (N=30)		CABG (N=30)		t test		
		Mean	SD	Mean	SD	t	p value	sig.
Age		57.8	8.3	56.8	10.0	0.422	0.675	NS
		PCI		CABG		Chi square		
		N	%	N	%	χ^2	p value	sig.
Sex	Male	22	73.3%	23	76.7%	0.089	0.766	NS
	Female	8	26.7%	7	23.3%			
Smoking	No	14	46.7%	14	46.7%	0	1.000	NS
	Yes	16	53.3%	16	53.3%			
HTN	No	22	73.3%	20	66.7%	0.317	0.573	NS
	Yes	8	26.7%	10	33.3%			
DM	No	18	60.0%	16	53.3%	0.271	0.602	NS
	Yes	12	40.0%	14	46.7%			
dyslipidemia	No	25	83.3%	23	76.7%	0.417	0.519	NS
	Yes	5	16.7%	7	23.3%			
Number of vessels	1	19	63.3%	6	20.0%	11.589	0.001	**S**
	2	11	36.7%	24	80.0%			

Table 2: Outcomes in both groups (test of significance Fisher exact test).

	PCI		CABG			
	N	%	N	%	p value	sig.
periprocedural mortality	2	6.7%	3	10.0%	1.000	NS
periprocedural complications	4	13.3%	6	20.0%	0.488	NS
immediate post procedural complication	6	20.0%	9	30.0%	0.371	NS
cardiovascular	5	16.7%	7	23.3%	0.519	NS
Stroke	1	3.3%	2	6.7%	1.000	NS
immediate post procedural mortality	1	3.3%	2	6.7%	1.000	NS
late post procedural complications	6	20.0%	2	6.7%	0.254	NS
repeat revascularization	5	16.7%	1	3.3%	0.195	NS
stroke	1	3.3%	1	3.3%	1.000	NS

Table 3: Complication in both groups.

Complications	**PCI**			**CABG**		
		N o	**%**		**N o**	**%**
Periprocedural	**LAD dissection**	**1**	**3.3**	**Severe bleeding**	**3**	**10**
	LCX acute occlusion	**2**	**6.6**	**Acute thrombosis**	**1**	**3.3**
	No reflow	**1**	**3.3**	**LIMA dissection**	**1**	**3.3**
				Stunning	**1**	**3.3**
Immediate postoperative	**Reinfarction**	**1**	**3.3**	**Acute MI**	**2**	**6.6**
	VT	**2**	**6.6**	**Severe bleeding**	**2**	**6.6**
	Heart failure	**2**	**6.6**	**Wound infection**	**1**	**3.3**
				Dehescent sternum	**1**	**3.3**
				Renal impairment	**1**	**3.3**
	Stroke	**1**	**3.3**	**Stroke**	**2**	**6.6**
Late complications	**Repeated revascularization**	**5**	**16.7**	**Repeated revascularization**	**1**	**3.3**
	Stroke	**1**	**3.3**	**Stroke**	**1**	**3.3**

The incidence of immediate post procedural complications was 20% in PCI group and 30% in the CABG group (p =0.37). These complications were cardiovascular complications (p =0.52) and stroke (p =1.0). Likewise, the incidence of immediate post procedural mortality was 3.3% in the PCI group and 6.7% in the CABG group (p =1.0). The incidence of late post procedural complications was 20% in PCI group and 6.7% in the CABG group (p =0.25). These complications were repeated revascularization (16.7% in PCI vs. 3.3% in CABG groups respectively) (p =0.19) and stroke (3.3% in both groups) (p =1.0), Table 2 and 3.

Discussion

In this retrospective review comparing stenting versus CABG for patients with LMCA disease in acute myocardial infarction, we found that PCI with stenting was non-inferior to CABG, as both techniques showed comparable rates of periprocedural mortality, periprocedural complications, immediate post procedural complication, immediate post procedural mortality, late post procedural complications, and repeated revascularization.

Our findings run in parallel with the EXCEL trial, which showed that both PCI was as effective as CABG in a particular subset of LMCA patients, who were deemed eligible for both techniques; the authors even concluded that PCI may be more favorable in this group given its less-invasive nature [17]. Likewise, the 5-year outcomes of first-generation DES and CABG were compared amongst patients with LMCA and SYNTAX score of ≤32. The results showed that patients in both groups had comparable rates of mortality, stroke, and MI [18,19]. According to the screening registry, about 62% and 80% of LMCA patients could be eligible for PCI and CABG, respectively. Revascularization decisions should be taken after discussion with the heart team members, considering each patient's preference based on his unique condition [20].

It should also be noted that the outcomes of PCI were expected to be improved after the initial studies, such as the SYNTAX trial, due to the improvement in the practice [18,19]. In the EXCEL trial, the rate of stent thrombosis was reduced significantly after using the everolimus-eluting stents. After the procedure and within three years, definite stent thrombosis was reported in less than 1%, which is a notably lower rate than the symptomatic graft occlusion [15,20]. In contrast, the use of paclitaxel-eluting stents in the SYNTAX study was associated with higher rate of stent thrombosis than graft occlusion [18,19]. In addition, nearly 80% of patients in the PCI group in the Stone et al. study used intravascular ultra sonographic imaging guidance (IVUS), which has been linked to a higher rate of event-free survival following LMCA stenting. Nevertheless, there have been advancements in CABG [20]. A significant reduction of surgery-related mortality and stroke rates was observed to be linked with the application of advanced techniques [20].

It was reported that newer-generation drug-eluting stents are associated with substantially enhanced mid-term outcomes, including reduction of all-cause mortality [21]. Furthermore, the use of fractional-flow reserve (FFR) instead of exclusively angiography-guided procedures, along with the use of IVUS, has resulted in increased PCI outcomes [22,23]. As such, the SYNTAX II study found that these advances were linked to a substantial decrease in adverse effects over time. Despite these advancements, most recent randomized studies have shown that CABG is reliably correlated with lower rates of repeated revascularization at mid-term follow-up as opposed to PCI, irrespective of stent form [24]. To assess the relative efficacy of PCI versus CABG, longer-term follow-up of trials comparing contemporaneous PCI with CABG is needed.

At a median follow-up of 7.5 years, the FREEDOM Follow-On analysis showed that CABG was associated with slightly fewer deaths than PCI in patients with multi vessel disease [25,26]. It was observed that diabetic patients who have more advanced coronary disease also benefit from CABG compared with PCI [27]. At ten years follow-up, the SYNTAX analysis showed no difference in survival between PCI and CABG in diabetic patients [19]. This result may be attributed to chance because the sample size was smaller (n=452) than in the FREEDOM trial (n=1900). Another point that could explain the discrepancy between the findings of the SYNTAX and FREEDOM studies is the length of follow-up, which is directly associated with the covered area in the Kaplan-Meier analysis.

We acknowledge that this study has some limitations, including the small sample size and the short follow-up period. In addition, we did not assess the SYNTAX score for our patients. All-cause mortality was not feasible to be collected in this study. Also, it was a single center study.

In conclusion, PCI and CABG had comparable postoperative outcomes in LMCA patients in the setting of acute myocardial infarction. Further randomized controlled trials with larger sample size and longer follow-up period are required to evaluate the safety and efficacy of both techniques in such patients.

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