

Short and long-term follow-up after coronary artery bypass surgery or percutaneous coronary intervention among elderly patients with multivessel disease

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Abstract

Aim: Compared to young patients, elderly patients are more prone to multivessel coronary artery disease, have more calcific coronary vessels, and experience greater delays in receiving medical help. Notably, differences in in-hospital and post-discharge mortality and morbidity rates have been observed between patient who underwent percutaneous coronary intervention (PCI) and coronary artery bypass graft (CABG). The present study primarily aimed to determine differences between CABG and PCI (with new-generation drug-eluting stents) among elderly patients with unstable angina pectoris (USAP) or non-ST segment elevation myocardial infarction (NSTEMI) and intermediate SYNTAX score.

Materials and Methods: This study evaluated the 441 consecutive elderly patients with with USAP or NSTEMI divided into two groups as PCI or CABG were retrospectively evaluated and followed up for 30 days and 5 years. All clinical incidents, such as all-cause mortality, cardiac death, myocardial infarction (MI), stroke, revascularization and stent thrombosis were recorded.

Results: Among the include patients, 200 received PCI (%45.4) and 241 (%54.6) received CABG. 1.3% and 4.8% of the patients in the PCI and CABG group developed a stroke, respectively ($p=0.048$). The PCI group (23%) exhibited a higher major adverse cardiovascular events percentage than the CABG group (18.7%), albeit not significantly ($p=0.264$). Repeat revascularization was required in 20 (10.1%) and 18 patients (10.8%) in the PCI and CABG group, respectively ($p = 0.337$). Among the included patients, 10.3% of those who underwent PCI developed MI, whereas only of 5.3% of those who underwent CABG developed the same ($p=0.045$). All-cause mortality rates at the 5-year follow-up were 12.7% (25 patients) and 9.1% (21 patients) in the PCI and CABG group, respectively ($p=0.225$). Accordingly, no difference in all-cause mortality between both groups was found during the first 30 days following revascularization ($p=0.13$). Moreover, Kaplan–Meier survival analysis showed a difference between PCI and CABG during the 5-year observation period.

Conclusion: No difference in all-cause mortality and repeat revascularization over a 5-year follow-up period was observed between the PCI and CABG groups. However, the CABG group had higher stroke rates, whereas the PCI group had higher MI rates.

Keywords: Acute coronary syndrome; coronary artery bypass graft; elderly patients; percutaneous coronary intervention

INTRODUCTION

Most studies on patients with stable coronary artery disease have demonstrated that coronary artery bypass graft (CABG) and percutaneous coronary intervention (PCI) promote similar total and cardiac mortality rates (1, 2). Nevertheless, while CABG has been shown to provide better repeat revascularization rates compared to PCI. Apart from their similarity in total mortality, both CABG and PCI have been found to exhibit similar myocardial infarction (MI) rates (2). However, although CABG protects patients from repeat interventions, it is a more aggressive procedure compared to PCI. On the other hand,

despite being a less aggressive procedure compared to CABG, PCI has been shown to promote higher repeat revascularization rates.

Owing to societal aging over the recent decades, the number of elderly patients with coronary artery disease (CAD) has continued to increase. Moreover, the treatment of CAD can be complicated by severe coronary artery damage and high global risk. As such, comparative studies play an important role within this population. Accordingly, most comparative studies focusing on this matter have been sub-analyses of large or retrospective studies (3,4).

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The decision to perform either CABG or PCI has been based on short- and long-term outcomes following the procedure. The life expectancy and quality of life among older individuals have been steadily improving. Over the past 2 decades, the definition of old age has progressed, initially being >70 years, followed by >75 years and now >80 years. North America and Europe have also seen an increase in the number of elderly patients. Given the increase in the percentage of individuals over 80, an increase in the number elderly patients requiring CABG can be expected (5). However, studies have yet to determine the prevalence of CABG and PCI among such elderly patients, while extracts from current research on younger patients (6) may not be reliable. Moreover, no scientific evidence has supported age-appropriate selection of revascularization strategies.

MATERIALS and METHODS

This study evaluated the 441 consecutive elderly patients (≥ 75 years) with unstable angina pectoris (USAP) or non-ST segment elevation myocardial infarction (NSTEMI) who undergone coronary revascularization therapy. The clinical outcomes evaluated up to the short and long terms defined as 30 days and 5 years after the index procedure. Study population was followed by the same physician during study period at the Central Clinic Hospital and Azerbaijan Medical University Department of Cardiology. Study protocol was approved by the Institutional Review Board (Ethical Committee of Azerbaijan Medical University, 29.11.2019, No:10)

Patients were included study; if (I) they had admitted with the diagnosis of USAP or NSTEMI according to recent guidelines (7) and had multi-vessel coronary artery disease (CAD) (at least two epicardial coronary arteries had $\geq 70\%$ stenosis) and had Syntax score between 22-33. Patients with left main CAD, history of previous cardiac surgery, previous PCI, cardiogenic shock, previous history of acute myocardial infarction (MI), new ST-Elevation Myocardial Infarction (STEMI) and elevated creatinine ($> 2\text{md/dl}$) were all excluded.

The clinical characteristics, laboratory parameters, and medical history were obtained from the patient charts recorded at the time of index hospitalization.

Definitions

Hypertension was defined as repeated systemic blood pressure measurements exceeding 140/90 mmHg or receiving antihypertensive medication (8).

Diabetes Mellitus (DM) was diagnosed as fasting blood glucose ≥ 126 mg/dL or blood glucose > 200 mg/dL at any time or use of anti-glycemic medication (9).

Hypercholesterolemia was defined as a baseline total cholesterol level > 200 mg/dL or current treatment with statins and/or lipid-lowering agents (10).

USAP was defined as discomfort on the chest or acceleration of previous angina which occurred during the

long-lasting exertion. ST-T changes was the supporting indicators of USAP. In that group of patient's normal troponin levels also supported the diagnosis of USAP (7).

Current smokers were those with regular smoking within the previous 6 months. Syntax score was calculated according to the SYNTAX score algorithm (11).

Standard techniques were used for PCI and new-generation drug-eluting stents were implanted in the PCI group. Dual antiplatelet therapy with aspirin and clopidogrel was recommended for at least 12 months after stent implantation.

All patients had evaluated with echocardiography by experienced echocardiographers according to European Association of Echocardiography/American Society of Echocardiography guidelines (12).

Follow-up and Outcomes

Patients were followed for 30 days and 5 years. Follow-up information was collected either via phone contact or by face-to face hospital visits. All clinical events, such as death associated with all causes, cardiac death, MI, stroke, revascularization, and stent thrombosis were recorded accordingly. Both short-term (within 30 days) and long-term (median 60 months) outcomes were evaluated. The primary endpoint of the study was short-term and long-term all-cause mortality. Major adverse cardiovascular events (MACE) that covered all-cause mortality, MI, stroke and repeat revascularization (11)

MI was defined as spontaneous, PCI related. The indicators of MI were new or pathologic Q wave and/or serum troponin levels elevations during the 5 years follow up. We investigated all causes of death. Death was divided into two group: cardiac and non-cardiac causes. Cancer related death was defined as a separate group. Cerebrovascular events were defined as acute, lasting at least 24-hour with a permanent loss of function and brain damage. All cerebrovascular events were confirmed by a neurologist and imaging methods.

Statistical Analysis

Research data were transferred to a computer and analyzed using IBM SPSS Statistics for Windows version 15.0 (IBM Corp., Armonk, NY, USA). The Kolmogorov-Smirnov test was used to determine the normality of continuous variable distribution. Categorical variables were presented as numbers and percentages, while continuous variables were presented mean and [standard deviation] for normally distributed data and median (minimum-maximum) for non-normally distributed data. The Mann-Whitney U test and Student's t-test were used to determine statistically significant differences in non-normally and normally distributed data between two independent groups, respectively. Pearson's chi-square test and Fisher's exact test were used to assess categorical variables. Differences in long-term outcomes were evaluated using the Kaplan-Meier curve with the log-rank test. A P value of < 0.05 was considered statistically significant.

RESULTS

Among the included patients, 200 (45.4%) underwent PCI, while 241 (54.6%) underwent CABG. The characteristics of both groups are summarized in Table 1. Accordingly, no significant differences in age, gender, prevalence of hypercholesterolemia, stroke, chronic kidney disease, left ventricular ejection fraction, current smoking status, and SYNTAX score were observed between the groups. The CABG group had significantly more patients with hypertension than the PCI group. The left internal mammary artery was used in 95% of patients who

underwent CABG. The mean follow-up duration was 60 months (interquartile range 50–68 months).

Both groups had similar all-cause mortality rates within the first 30 days following index revascularization ($p = 0.241$). During this time, the CABG group experienced more strokes than the PCI group (1 in the PCI group vs. 5 in the CABG group; $p = 0.004$). At 30 days, 11 (5.6%) and 10 patients (4.1%) in the PCI and CABG group developed MACE, respectively ($p = 0.615$). The PCI group (4.1%) had more repeat revascularizations than the CABG group (1.3%) during the aforementioned period ($p = 0.004$) (Table 2).

Table 1. Clinical characteristics of the included patients

Patient characteristics	PCI (n = 200)	CABG (n = 241)	P value
Age, years	74.1 ± 2.08	74.38 ± 1.6	0.26
Women, n (%)	48 (24%)	55 (22.8%)	0.77
Type 2 diabetes mellitus	50 (25%)	78 (32.4%)	0.09
Hypercholesterolemia, n (%)	124 (61.8%)	149 (62.1%)	0.73
Current smoker, n (%)	32 (15.8%)	39 (16.1%)	0.74
Previous stroke, n (%)	2 (1%)	2 (0.8%)	0.85
Hypertension, n (%)	95 (47.5%)	187 (77.6%)	<0.001
CKD (creatinine 150-200 mg/dL), n (%)	11 (5.5%)	16 (6.6%)	0.62
Left ventricular ejection fraction, %	45.7%	47.4%	0.25
SYNTAX score	27.1	27.7	0.07

CKD = Chronic kidney disease

Table 2. Estimates of major adverse cardiovascular and cerebrovascular events at one month and five years after percutaneous coronary intervention and coronary artery bypass graft

	One-month follow-up, n (%)			Five-year follow-up, n (%)		
	PCI	CABG	P value	PCI	CABG	P value
MACE	11 (5.6%)	10 (4.1%)	0.61	46 (23%)	45 (18.7%)	0.26
Death	2 (0.90%)	4 (1.8%)	0.24	25 (12.7%)	21 (9.1%)	0.23
Myocardial infarction	3 (2%)	5 (1.9%)	0.76	20 (10.3%)	13 (5.3%)	0.045
Stroke	1 (0.6%)	5 (2.1%)	0.004	3 (1.3%)	12 (4.8%)	0.048
Repeat revascularization	8 (4.1%)	3 (1.3%)	0.004	20 (0.1%)	18 (10.8%)	0.33
Primary endpoints	14 (7.2%)	10 (4.2%)	0.21	38 (19%)	52 (21.5%)	0.63

At the 5-year follow-up, 25 (12.7%) and 21 patients (9.1%) in the PCI and CABG group succumbed to all-cause mortality ($p = 0.225$). The PCI group (23%) had higher MACE rates than the CABG group (18.7%), though the difference was not significant ($p = 0.264$). Repeat revascularizations were required in 20 (10.1%) and 18 patients (10.8%) in the PCI and CABG group, respectively ($p = 0.337$). Moreover, 1.3% and 4.8% of the patients in the PCI and CABG group experienced a stroke ($p = 0.048$).

Among all patients with ACS, MI occurred in 10.3% and 5.3% of those who underwent to PCI and CABG, respectively ($p = 0.045$) (Table 2).

Only 25 deaths occurred in the PCI group, 47.8% of which were caused by cardiac causes (11 cases) and 52.2% by extracardiac causes (12 cases) (e.g., cancer). Moreover, 21 deaths occurred in the CABG group, 52.4% of which were due to cardiac causes (11 deaths) and 47.6% to extracardiac causes (e.g., cancer) (10 cases) ($p = 0.05$).

Kaplan–Meier survival analysis showed a difference between PCI (using new-generation drug-eluting stents) and CABG over the 5-year observation period ($p = 0.029$) (Figure 1).

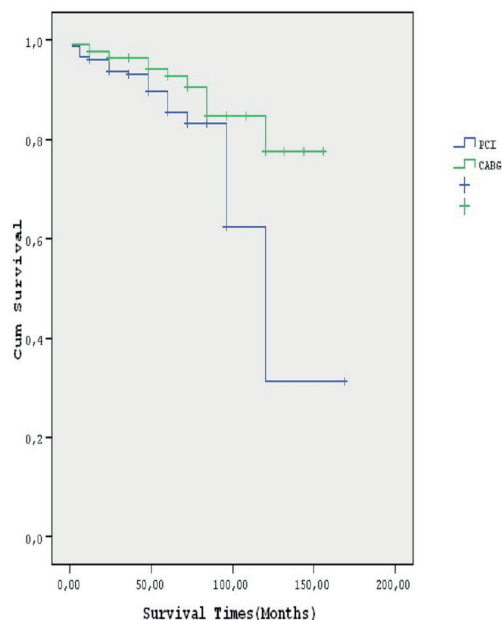


Figure 1. Kaplan–Meier estimates of cumulative survival from all- cause death among patients who underwent percutaneous coronary intervention and coronary artery bypass graft

DISCUSSION

The current study showed that 1.3% and 4.8% of patients in the PCI and CABG group experienced stroke during the 5-year observation period, respectively. Moreover, the primary endpoint, which included death, MI, and stroke, was observed in 46 (23%) and 45 patients (18.7%) in the PCI and CABG group, respectively, although no significant difference was noted. Furthermore, no difference in all-cause mortality had been found throughout the 5-year follow-up period.

In the SYNTAX trial, Mohr and colleagues compared PCI (using TAXUS stents) with CABG among patients with three-vessel disease and coronary artery disease. Accordingly, their results showed that the CABG group had a considerably lower major adverse cardiac and cerebrovascular event rate compared to the PCI group (26.9% vs. 37.3%, respectively). Moreover, the CABG group exhibited lower MI and repeat revascularization rates compared to the PCI group (3.8% vs. 9.7% and 13.7% vs. 25.9%, respectively). Nonetheless, the aforementioned large-scale study covered all age groups(6). Although the present study showed that PCI group had higher MACE rates compared to the CABG group, the difference was not statistically significant. Similar results were observed for repeat revascularization in our study. Accordingly, the results obtained herein were rooted in the use of new-generation stents. Unlike first-generation drug-eluting stents, newer generation stents have very thin polymer portions that are completely absorbed within 6 months of implantation, thereby promoting a significant reduction in both short- and long-term MI and death after the procedure (13).

A study conducted by Edward and colleagues had similar mortality and stroke/MI/mortality rates among elderly patients as those reported herein. However, the CABG group had much lower repeat revascularization rates than the PCI group in the aforementioned study(14), which differed from that observed herein where no difference in repeat revascularization was found between both groups. Unlike the study by Edward and colleagues, the current study utilized new-generation drug-eluting stents and dilation with a non-compliant balloon (NC) in high atmosphere after stent placement during PCI, which may explain the difference in results for repeat revascularization. New-generation stents do not have a polymer coating. Moreover, the high atmospheric expansion of such stents with the NC balloon prevents stent malposition, which has been among the major causes of recurrent restenosis. Our Kaplan–Meier survival analysis clearly showed that CABG produced significantly better results than PCI.

A study conducted by Mineok Chang and colleagues revealed that CABG promoted much lower MACCE rates among patients aging 70–89 years who had left main coronary artery and multivessel disease compared to PCI. This advantage of CABG made it suitable for patients with high, but not low, SYNTAX scores. Moreover, the aforementioned study found no difference in all-cause mortality, stroke risk, and mortality between the two groups. The same trial showed that PCI using drug-eluting stents could be performed as a treatment for elderly patients with anatomically less complex main coronary artery disease and multivessel disease (15).

The ASCERT study (ACCF and STS database on the comparative efficacy of revascularization strategies) compared 86,244 patients who underwent CABG with 103,549 patients who underwent PCI, all of whom were aged ≥ 65 years and had stable multivessel disease. Accordingly, this study has similar mortality rates in both groups within a year. After 4 years, however, the CABG group had a significantly lower adjusted risk ratio for all-cause mortality compared to the PCI group (relative risk 0.78; 95% confidence interval, 0.74–0.82). This increase in the benefits of CABG over time indicates its long-term advantage over PCI with drug-eluting stents. Moreover, this difference remained consistent regardless of age, sex, diabetes, and left ventricular ejection fraction (4).

Elderly patients who underwent CABG had been found to have higher perioperative stroke rates compared to those who underwent PCI. This remains one of the most important concerns encountered among patients who undergo CABG. Nevertheless, given the recent advancements in perioperative management and surgical techniques, the frequency of strokes after CABG has decreased significantly (16,17) such that the CREDO-Kyoto (Coronary Revascularization Demonstrating Outcomes Study-Kyoto) found no difference in stroke frequency between off-pump CABG and PCI (18).

The current study found that the CABG group had a higher stroke rate than the PCI group at the 5-year follow-up. In the retrospective, observational multicenter CREDO-Kyoto study registry involving more than 25,000 patients, the authors randomly selected 5651 patients with three-vessel disease and randomized them to PCI groups with and without drug-eluting stents. Accordingly, the study showed that the PCI group had a higher mortality rate than the CABG group, which was mainly reflected in patients over 74 years old. The results for CABG and PCI were consistent in two other groups comprising young patients. Compared to CABG, PCI also had higher rates for cardiac death, MI, heart failure, hospitalization, and new coronary interventions. However, both groups had similar risk for sudden death, although the PCI group had lower stroke rates (19). Consistent with the CREDO-Kyoto study and others, the present study found that the PCI group had a higher MI rates than the CABG group.

LIMITATIONS

The current study has several limitations. First, this was a retrospective study that was conducted in only one center. The retrospective design of the study may have resulted in selection bias allocating patients to one of the two revascularization strategies. Second, only a small number of patients had been included. Third no regression analysis was made to correct for the differences in baseline variables. In addition, in both groups we may have included patients who had an absolute contraindication for the other revascularisation strategy. Lastly, we were unable to measure quality of life.

CONCLUSION

The present study found no difference in all-cause mortality and repeat revascularization between the PCI and CABG groups throughout the 5-year follow-up period. However, the CABG group exhibited higher stroke rates, but lower MI rates compared to the PCI group.

Competing Interests: The authors declare that they have no competing interest.

Financial Disclosure: There are no financial supports.

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