DOI: http://dx.doi.org/10.22122/arya.v16i2.2019 Published by Vesnu Publications

Comparison of survival rate and complications of percutaneous coronary intervention, coronary artery bypass graft, and medical treatment in patients with left main and/or three vessel diseases

Alireza Khosravi[1], Mehrbod Vakhshoori[2], Vahid Sharif[3], Farshad Roghani-Dehkordi[4], Jamshid Najafian[5], Asieh Mansouri[6]

Original Article

Abstract

BACKGROUND: The probable complications of 3 different cardiovascular diseases treatment options including percutaneous coronary intervention (PCI), coronary artery bypass graft (CABG), and medical therapy (MT), especially in individuals suffering from left main (LM) and/or three vessel diseases (3VDs), have received less attention. Thus, the aim of this study was to compare the complications of the aforementioned therapeutic strategies in patients admitted with LM coronary artery disease (CAD) and/or having 3VDs.

METHODS: From March 2018 to March 2019, a total number of 251 eligible individuals (87, 86, and 78 subjects treated with PCI, CABG, and MT, respectively) were recruited in this cohort study. After the initiation of treatment, all individuals were followed for 6 months. Occurrence of any complications including chest pain (CP), re-hospitalization due to cardiac problems, heart failure (HF), death, myocardial infarction (MI), and stroke as well as major adverse cardiac events (MACE) were assessed.

RESULTS: Significantly lower percentages of CP, readmission, and HF were observed in the CABG group compared to the PCI and MT groups (24.4% vs. 47.1% and 53.9%, P < 0.001; 3.5% vs. 13.8% and 5.1%, P = 0.020; 1.2% vs. 2.3% and 9%; P = 0.040, respectively). Further analysis revealed an increased likelihood of hospitalization in the PCI group (OR: 3.82, 95% CI: 1.01-14.41, P = 0.040), and a lower risk of CP and HF occurrence in the CABG group subjects compared to the MT group (OR: 0.28, 95% CI: 0.13-0.62, P = 0.002 and OR: 0.05, 95% CI: 0.004-0.71, P = 0.030, respectively). This pattern was also observed in the PCI group in terms of HF (OR: 0.12, 95% CI: 0.02-0.83, P = 0.030).

CONCLUSION: Patients suffering from LM and/or 3VDs would most likely benefit from CABG followed by PCI, rather than MT. Further large-scale studies are required to confirm these results.

Keywords: Coronary Artery Bypass Grafting; Percutaneous Coronary Intervention; Coronary Vessels; Coronary Artery Disease

Date of submission: 24 May 2019, ***Date of acceptance:*** 28 July 2019

Introduction

One of the leading causes of death among all nations is cardiovascular diseases (CVDs); 50 and 25% of deaths are attributable to CVDs in developed and developing countries, respectively.[1,2] Due to the importance of the diagnosis and treatment of these disorders, several diagnostic and therapeutic procedures have been introduced in this regard; the

How to cite this article: Khosravi A, Vakhshoori M, Sharif V, Roghani-Dehkordi F, Najafian J, Mansouri A. **Comparison of survival rate and complications of percutaneous coronary intervention, coronary artery bypass graft, and medical treatment in patients with left main and/or three vessel diseases.** ARYA Atheroscler 2020; 16(2): 85-93.

1- Professor, Interventional Cardiology Research Center, Cardiovascular Research Institute, Isfahan University of Medical Sciences, Isfahan, Iran
2- Heart Failure Research Center, Cardiovascular Research Institute, Isfahan University of Medical Sciences, Isfahan, Iran
3- Hypertension Research Center, Cardiovascular Research Institute, Isfahan University of Medical Sciences, Isfahan, Iran
4- Professor, Cardiac Rehabilitation Research Center, Cardiovascular Research Institute, Isfahan University of Medical Sciences, Isfahan, Iran
5- Associate Professor, Isfahan Cardiovascular Research Center, Cardiovascular Research Institute, Isfahan University of Medical Sciences, Isfahan, Iran
6- Assistant Professor, Hypertension Research Center, Cardiovascular Research Institute, Isfahan University of Medical Sciences, Isfahan, Iran
Address for correspondence: Asieh Mansouri; Assistant Professor, Hypertension Research Center, Cardiovascular Research Institute, Isfahan University of Medical Sciences, Isfahan, Iran; Email: mansouri.arn@gmail.com

oldest diagnostic method is coronary angiography that was performed for the first time in 1929.[3] Coronary artery bypass graft (CABG) surgery and percutaneous coronary intervention (PCI) are 2 other methods first introduced in 1968 and 1977, respectively.[4,5] CABG was first considered for complex coronary lesions and was announced as a standard therapy for left main (LM) coronary artery disease (CAD); however, technology and device improvement in PCI method have been so great that this procedure has been categorized as an alternative way of managing complex coronary artery lesions.[6-8] However, each modality has its own advantages and disadvantages especially in terms of the procedure itself and post procedural complications. In comparison to CABG, in some studies PCI has been associated with increased incidence of repeat revascularization, re-infarction, or angina recurrence.[1,9-11] On the other hand, in spite of the heightened quality of life (QOL) after CABG surgery reported in some researches, this procedure has been associated with increased prevalence of complications including stroke, cardiac death, or heart failure (HF) worsening compared to PCI.[12,13] Moreover, insignificant associations have been reported between aforementioned variables in addition to the comparison of the 2 methods with medical therapy in some other articles.[1,14]

Due to the controversial findings of previous studies and considering that no previous study was found to compare the occurrence of complications after PCI, CABG, or medical treatment between patients suffering from LM CAD, the aim of the current study was to evaluate the incidence of complications including chest pain (CP), re-hospitalization due to cardiac problems, HF, death, myocardial infarction (MI), stroke, and major cardiac events (death, fatal/nonfatal MI, and stroke) in Iranian adults suffering from LM CAD and/or 3 vessel diseases (3VDs) who had experienced 3 distinct therapeutic strategies including PCI, CABG, or medical treatment (MT) within 6 months after the initiation date of treatment.

Materials and Methods

This prospective, cohort study was performed from March 2018 to March 2019 in 2 governmental hospitals (Chamran and Asgariye) in Isfahan, Iran. Any individual aged at least 18 years who had LM coronary artery lesion and/or 3VDs and was willing to participate would be recruited for this study. Based on therapeutic strategies, the participants were divided into 3 distinct groups including PCI, CABG, and MT. The decision to perform each aforementioned modality was based on the cooperative interaction of patient and physician. Patients preference, anatomical conditions of coronary arteries, as well as utilization of appropriate guidelines[15] for the correct selection of patients were some contributing factors that ultimately resulted in the classification of participants in our pre-defined treatment options. Presence of any conditions including incompleteness of profiles in data registry or during follow-up evaluation, previously defined malignancy or New York Heart Association (NYHA) class of IV HF were the exclusion criteria. After the implementation of the inclusion and exclusion criteria, data on 251 individuals (PCI = 87, CABG = 86, and MT = 78) were available for analysis. All participants were totally free to leave the study at any time without any probable future consequences. This study was approved by the ethics committee of Isfahan University of Medical Sciences, Isfahan, Iran (IR.MUI.MED.REC.1397.332).

Demographic characteristics and past medical histories including age, smoking status, hypertension (systolic blood pressure ≥ 140 mmHg and/or diastolic blood pressure ≥ 90 mmHg, or consuming anti-hypertensive agents), hyperlipidemia (using medications for lipid disorders, triglyceride ≥ 150 mg/dl, total cholesterol ≥ 220 mg/dl, or low density lipoprotein cholesterol ≥ 160 mg/dl), diabetes mellitus (DM) (fasting blood sugar ≥ 126 mg/dl, or using anti-diabetic drugs), history of previous MI, stroke, transient ischemic attack (TIA), peripheral vascular diseases, chronic obstructive pulmonary disease (COPD), and chronic kidney diseases (CKD) were measured and assessed through a dichotomous scale (yes/no questions), wherever it was appropriate. The number of coronary artery occlusions as well as specific involved vessels was assessed through each participant's relevant documentations including medical forms or coronary angiography videos. Information about the cause of hospitalization was gathered through a questionnaire scored on a 4-point scale [stable angina, unstable angina, ST-segment elevation MI (STEMI), non-STEMI (NSTEMI)].

A follow-up assessment was conducted for each patient within 6 months after the initiation of each treatment strategy. In the follow-up assessment, the participants were contacted by phone and asked about the occurrence of any complications including CP, re-hospitalization due to cardiac problems, HF, death, MI, and stroke. The term "major adverse cardiac events" (MACE) was defined in order to aggregate and assess the 3 most life-threatening and debilitating cardiovascular complications including death, and fatal/nonfatal MI or stroke. In the case of incidence of any adverse events, the patient or family members were asked to bring relevant documentations of the declared complication. A group consisting of 2 cardiologists and 1 neurologist made the ultimate decision about the mentioned adverse outcomes.

Categorical and continuous variables were reported as frequency (percentage) and mean ± standard deviation (SD), respectively. The chi-square test (Fisher's exact test when assumptions of chi-square test were violated) and one way ANOVA were, respectively, used to compare categorical and continuous variables between the 3 treatment groups. Cardiovascular events including CP, HF, and re-hospitalization due to cardiac problems were compared using logistic regression and crude and adjusted Cox proportional hazards regression model (adjusted for age, gender, smoking status, DM, CKD, LM with 3VDs and gender, and DM and CKD). These comparisons were performed between the 3 groups (considering the MT group as reference) and as pairwise comparisons. The Kaplan-Meier curves with assessment of group differences using log-rank test were constructed for individuals who had undergone PCI, CABG, and MT to re-hospitalization. All analyses were performed using Stata statistical software (version 11.0; StataCorp., College Station, Tex, USA). P-values of less than 0.050 were considered statistically significant.

Results

Among the 251 participants of this cohort study, 192 (76.4%) were men. The mean age of the total population was 64.53 ± 10.2 years. Baseline characteristics of the study participants in total and according to treatment groups are presented in table 1.

Table 1. Demographic characteristics of the study population according to different categories of treatment modalities

Variables		Total (n = 251)	PCI (n = 87)	CABG (n = 86)	Medical Treatment (n = 78)	P
Age (year)		64.53 ± 10.2	63.85 ± 11.4	63.84 ± 9.2	66.0 ± 9.9	0.310*
Male (%)		192 (76.4)	69 (79.3)	65 (75.6)	58 (74.4)	0.730**
Smoking (%)		27 (10.9)	12 (14.1)	10 (11.8)	5 (6.4)	0.270**
Hypertension (%)		95 (40.1)	32 (38.6)	32 (40.0)	31 (41.9)	0.910**
Hyperlipidemia (%)		44 (18.4)	15 (18.1)	10 (12.4)	19 (25.3)	0.110**
Diabetes mellitus (%)		91 (36.3)	28 (32.2)	27 (31.4)	36 (46.2)	0.090**
MI history (%)		4 (1.6)	1 (1.2)	2 (2.3)	1 (1.3)	1.000***
Stroke history (%)		0 (0.0)				
TIA history (%)		0 (0.0)				
Peripheral vascular disease (%)		1 (0.4)	1 (1.2)	0 (0.0)	0 (0.0)	0.650***
COPD (%)		2 (0.8)	1 (1.2)	0 (0.0)	1 (1.3)	0.080***
CKD (%)		22 (8.8)	12 (13.8)	4 (4.7)	6 (7.7)	0.090**
Lesion extent (%)	LM and Single vessel	11 (4.4)	2 (2.3)	8 (9.3)	1 (1.3)	0.030***
	LM and Two vessels	32 (12.8)	7 (8.1)	19 (22.1)	6 (7.7)	0.006**
	Three vessels	204 (81.3)	78 (89.7)	55 (64.0)	71 (91.0)	< 0.001**
	Left main	105 (41.8)	24 (27.6)	69 (80.2)	12 (15.4)	< 0.001**
	TVD and LM	58 (23.1)	15 (17.2)	38 (44.2)	5 (6.4)	< 0.001**
Lesion segment (%)	LAD	242 (96.4)	86 (98.9)	78 (90.7)	78 (100.0)	0.002**
	LCX	222 (88.5)	81 (93.1)	69 (80.2)	72 (92.3)	0.010**
	RCA	222 (88.5)	81 (93.1)	65 (75.6)	78 (97.4)	< 0.001**
Clinical status on admission (%)	Stable angina	148 (59.0)	43 (49.4)	55 (64.0)	50 (64.1)	0.080**
	Unstable angina	60 (23.9)	20 (23.0)	20 (23.3)	20 (25.6)	0.910**
	STEMI					
	Non-STEMI					

* One-way ANOVA, ** Chi-square test, *** Fisher's exact test

PCI: Percutaneous coronary intervention; CABG: Coronary artery bypass graft; MI: Myocardial infarction; TIA: Transient ischemic attack; COPD: Chronic obstructive pulmonary disease; CKD: Chronic kidney disease; TVD & LM: Three vessel disease with left main disease; LAD: Left anterior descending; LCX: Left circumflex coronary artery; RCA: Right coronary artery; STEMI: ST-segment elevation myocardial infarction

Table 2. Cardiovascular outcomes incidence of the study population across different categories of treatment modalities

Variables	Total (n = 251)	PCI (n = 87)	CABG (n = 86)	MT (n = 78)	P
Chest pain (%)	104 (41.4)	41 (47.1)	21 (24.4)	42 (53.9)	< 0.001*
Hospitalization due to cardiac problems (%)	19 (7.6)	12 (13.8)	3 (3.5)	4 (5.1)	0.020*
Heart failure (%)	10 (3.4)	2 (2.3)	1 (1.2)	7 (9.0)	0.040**
Death (%)	6 (2.4)	2 (2.3)	2 (2.3)	2 (2.6)	1.000**
Myocardial infarction (%)	2 (0.8)	1 (1.2)	1 (1.2)	0 (0.0)	0.990**
Stroke (%)	3 (1.2)	2 (2.3)	1 (1.2)	0 (0.0)	0.770**
MACE (%)	10 (4.0)	4 (4.6)	4 (4.7)	2 (2.6)	0.740*

* Chi-square test, ** Fisher exact test

PCI: Percutaneous coronary intervention; CABG: Coronary artery bypass graft; MT: Medical treatment; MACE: Major adverse cardiac events

There were no significant differences between the groups in terms of age, gender, smoking, hypertension, hyperlipidemia, DM, history of previous MI, peripheral vascular disease, COPD, CKD, stable and unstable angina, STEMI and NSTEMI. However, we observed significant differences between these groups in terms of lesion extent and lesion segment; patients with LM and single vessel, LM and two vessels, LM and three vessels, and isolated LM were significantly dominated in CABG group. Furthermore, participants in the MT group had higher percentages of isolated three vessels involvement. Although the MT group had higher percentages of left anterior descending (LAD) and right coronary artery[1] obstruction, left circumflex (LCX) artery occlusion was more prevalent among patients who had undergone PCI.

The incidence of cardiovascular events at the end of the follow-up period is presented in table 2. Among all outcomes investigated during the 6-month follow-up period, there were only significant differences between the groups in terms of CP, HF, and re-hospitalization due to cardiac problems. CP was the most prevalent outcome during a 6-month period after the beginning of the treatment. Other outcomes occurred less frequently in the total population. The comparison of these outcomes between the groups illustrated significant differences in terms of CP, re-hospitalization due to cardiac problems, and HF. While the MT group had the highest incidence rate of HF and CP compared with its counterparts, patients who had undergone PCI had the highest incidence rate of re-hospitalization due to cardiac problems.

Due to lack of data on the exact time of occurrence of CP and HF, we were not able to estimate the hazard ratio of these outcomes based on various treatment groups using the Cox proportional hazards model. Therefore, we had to use odds ratio (OR) using logistic regression (Table 3). After adjustment of all potential confounders, participants who had undergone CABG had lower odds of CP and HF compared to the MT group (OR: 0.28, 95% CI: 0.13–0.62, P = 0.002 and OR: 0.05, 95% confidence interval (CI): 0.00–0.71, P = 0.030, respectively). Similarly, the PCI group showed reduced odds of HF in comparison to the reference group (OR: 0.12, 95% CI: 0.02–0.83, P = 0.030).

Table 3. Odds ratio of chest pain and heart failure across different categories of treatment modalities

Outcomes	Models	Treatment options	OR (95% CI)	P
Chest pain	Unadjusted	Medical treatment	1.00 (reference)	-
		PCI	0.76 (0.41-1.04)	0.380
		CABG	0.28 (0.14-0.54)	< 0.001
	Adjusted*	Medical treatment	1.00 (reference)	-
		PCI	0.75 (0.38-1.48)	0.410
		CABG	0.28 (0.13-0.62)	0.002
Heart failure	Unadjusted	Medical treatment	1.00 (reference)	-
		PCI	0.24 (0.05-1.12)	0.080
		CABG	0.12 (0.01-0.99)	0.040
	Adjusted*	Medical treatment	1.00 (reference)	-
		PCI	0.12 (0.02-0.83)	0.030
		CABG	0.05 (0.00-0.71)	0.030

* Adjusted for age, gender, smoking status, diabetes mellitus, chronic kidney disease, and left main with three vessel diseases

OR: Odds ratio; CI: Confidence interval; PCI: Percutaneous coronary intervention; CABG: Coronary artery bypass graft

The estimated hazard ratio of re-hospitalization due to cardiac problems in PCI and CABG groups compared with the MT group using the Cox proportional hazards model is presented in table 4. In individuals who had previously undergone PCI as the pre-defined therapeutic modality, the likelihood of re-hospitalization due to cardiac problems had increased during the follow-up period in comparison to the MT group (OR: 3.82, 95% CI: 1.01-14.41, P = 0.040).

Table 4. Hazard ratio of re-hospitalization due to cardiac problems across different categories of treatment modalities

Models	Variables	HR (95% CI)	P
Unadjusted	Medical treatment	1.00 (reference)	-
	PCI	4.23 (1.13-15.83)	0.030
	CABG	0.81 (0.16-4.01)	0.790
Adjusted*	Medical treatment	1.00 (reference)	-
	PCI	3.82 (1.01-14.41)	0.040
	CABG	0.88 (0.18-4.43)	0.870

* Adjusted for gender, diabetes mellitus, and chronic kidney disease HR: Hazard ratio; CI: Confidence interval; PCI: Percutaneous coronary intervention; CABG: Coronary Artery Bypass Graft

The results of pairwise comparisons of CP, HF, and re-hospitalization according to different treatment options are presented in table 5. Compared to the PCI and MT groups, individuals who had undergone CABG had lower odds of CP after adjustment of potential confounding variables (OR: 0.30, 95% CI: 0.14-0.63, P = 0.002 and OR: 0.30, 95% CI: 0.13-0.68, P = 0.004, respectively). In terms of HF, both CABG and PCI groups had lower odds in comparison to the MT group (OR: 0.06, 95% CI: 0.01-0.72, P = 0.020 and OR: 0.15, 95% CI: 0.02-0.93, P = 0.040, respectively), but the difference between the PCI and CABG groups was not statistically significant (P = 0.670). The odds of re-hospitalization was lower in participants who had undergone CABG compared to the PCI group (OR: 0.23, 95% CI: 0.06-0.88, P = 0.030), but patients with a history of PCI showed an increased odds of readmission rather compared to the MT group (OR: 4.09, 95% CI: 1.05-15.89, P = 0.040).

The Kaplan-Meier curves for re-hospitalization due to cardiac problems according to treatment groups are displayed in Figure 1. Figure 1 shows that individuals with prior PCI had a significantly lower readmission free interval compared to the other treatment categories (P = 0.007).

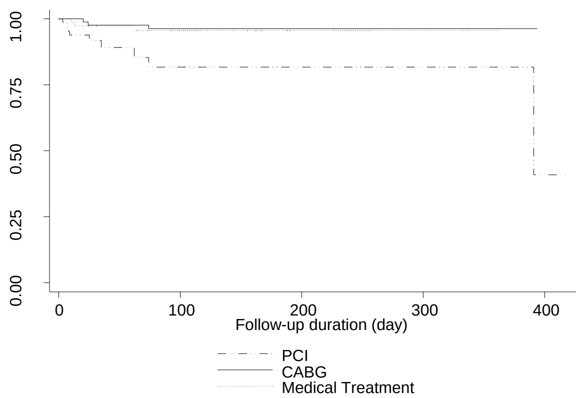

Figure 1. Kaplan-Meier curves for hospitalization due to cardiac problems according to different categories of treatment modalities

PCI: Percutaneous coronary intervention; CABG: Coronary artery bypass graft

Discussion

The aim of the current study was to evaluate the probability of the occurrence of cardiovascular complications in patients who had LM and/or 3VDs and had undergone 3 different treatment methods including PCI, CABG, and MT. Our findings revealed significantly lower prevalence of CP, HF, and re-hospitalization rate among individuals who had undergone CABG compared to other therapy modalities. Further analysis during a 6-month follow-up period revealed 72% and 95% decrease in likelihood of CP and HF incidence, respectively, in the CABG group in comparison to the MT group. Similarly, the PCI group had an 88% reduction in the risk of HF compared to individuals who had not received any invasive procedures. Moreover, a 3.82 times higher risk of re-hospitalization due to cardiac problems within a 6-month follow-up duration was observed in the PCI group compared to individuals who preferred only medication usage. Furthermore, in pairwise comparisons, the CABG group had lower risk of CP compared with either the PCI or MT group. Although both CABG and PCI methods have been associated with a lower risk of HF in comparison to MT as reference group, the comparison of this variable between the CABG and PCI groups did not reveal any significant differences. With respect to re-hospitalization, participants who had undergone CABG and PCI had reduced and increased odds of this outcome compared with the PCI and MT groups, respectively.

Table 5. Odds ratio of chest pain and heart failure, and hazard ratio of re-hospitalization due to cardiac problems across different categories of treatment modalities

Outcomes	Models	Treatment options	OR (95% CI)	P
Chest pain	Unadjusted	PCI	1.00 (reference)	0.002
		CABG	0.36 (0.19-0.69)	
	Adjusted*	PCI	1.00 (reference)	0.002
		CABG	0.30 (0.14-0.63)	
	Unadjusted	Medical treatment	1.00 (reference)	< 0.001
		CABG	0.28 (0.14-0.54)	
	Adjusted*	Medical treatment	1.00 (reference)	0.004
		CABG	0.30 (0.13-0.68)	
	Unadjusted	Medical treatment	1.00 (reference)	0.390
		PCI	0.76 (0.41-1.41)	
	Adjusted*	Medical treatment	1.00 (reference)	0.460
		PCI	0.78 (0.39-1.51)	
Heart failure	Unadjusted	PCI	1.00 (reference)	0.570
		CABG	0.50 (0.04-5.61)	
	Adjusted*	PCI	1.00 (reference)	0.670
		CABG	2.38 (0.04-124.08)	
	Unadjusted	Medical treatment	1.00 (reference)	0.040
		CABG	0.12 (0.01-0.99)	
	Adjusted*	Medical treatment	1.00 (reference)	0.020
		CABG	0.06 (0.01-0.72)	
	Unadjusted	Medical treatment	1.00 (reference)	0.080
		PCI	0.24 (0.05-1.18)	
	Adjusted*	Medical treatment	1.00 (reference)	0.040
		PCI	0.15 (0.02-0.93)	
Outcomes	**Models**	**Treatment options**	**Hazard Ratio (95% CI)**	**P**
Re-hospitalization due to cardiac problems	Unadjusted	PCI	1.00 (reference)	0.010
		CABG	0.18 (0.05-0.70)	
	Adjusted**	PCI	1.00 (reference)	0.030
		CABG	0.23 (0.06-0.88)	
	Unadjusted	Medical treatment	1.00 (reference)	0.830
		CABG	0.84 (0.17-4.14)	
	Adjusted**	Medical treatment	1.00 (reference)	0.880
		CABG	0.88 (0.17-4.56)	
	Unadjusted	Medical treatment	1.00 (reference)	0.030
		PCI	4.17 (1.10-15.78)	
	Adjusted**	Medical treatment	1.00 (reference)	0.040
		PCI	4.09 (1.05-15.89)	

OR: Odds ratio; CI: Confidence interval; PCI: Percutaneous coronary intervention; CABG: Coronary artery bypass graft
* adjusted for age, gender, smoking status, diabetes mellitus, chronic kidney disease, and left main with three vessel diseases
** adjusted for gender, diabetes mellitus, and chronic kidney disease

Since CVDs remain the main cause of mortality and morbidity all over the world, the selection of appropriate treatment modalities in order to decline the rates of possible complications is reasonable, especially in patients with LM and/or 3VDs. The findings of several published studies were in agreement with our findings in this regard. For instance, in a randomized clinical trial, 1800 patients suffering from LM CAD or 3VDs were randomly assigned to CABG (n = 897) and PCI (n = 903) categories. After 5 years of follow-up, their outcomes suggested that CABG was associated with lower prevalence of repeated coronary revascularization in comparison to PCI (13.7% vs. 25.9%, P < 0.0001). Similarly, no significant differences were found in terms of death or stroke occurrence between the two distinct interventions.[10] Deo et al. performed a systematic review and meta-analysis study in order to investigate possible cardiovascular complications in CABG or PCI method.[11] Their analysis on 12 relevant studies including 7 randomized clinical trials and 5 observational articles on more than 2000 individuals within 2-5 years after treatment implementation revealed that, in spite of the insignificant difference in terms of mortality between PCI and CABG method, angina and necessity for coronary artery revascularization were less frequently observed in individuals who had undergone CABG compared to PCI, especially with the usage of drug-eluting stent [relative risk (RR): 3.4, 95% CI: 1.9-6.2, P < 0.001 and RR: 4.16, 95% CI: 2.7-6.6, P < 0.001, respectively).[11] In the study by Mercado et al., a total number of 2051 individuals were divided into CABG (n = 1533) and PCI (n = 1518) categories and were assessed after 1 year of follow-up using a database of 4 distinct trials and probable adverse events related to the aforementioned treatment options.[1] They reported neither death nor MI as well as a difference in stroke prevalence between the groups. However, participants who had undergone PCI had, respectively, lower and increased likelihood of chest pain free intervals and repeated coronary artery revascularization compared to those who had undergone surgery (77% vs. 82%, P = 0.002 and 18% vs. 4.4%, HR: 4.4, 95% CI: 3.3-5.9, respectively).[1] Furthermore, Wang et al. performed a systematic review on 16900 individuals using data from 19 related articles in order to compare complications in subjects with a history of PCI or CABG on LM coronary artery lesions.[8] Their pooled analysis failed to prove any significant differences in terms of all-cause mortality in either groups, but patients who had undergone PCI had a higher chance of repeat revascularization compared to those who had undergone CABG (OR: 2.47, 95% CI: 1.80-3.37).[8] Another meta-analysis performed on 1611 subjects with a pre-defined follow-up duration of 1 year revealed that there were no significant differences in terms of all major adverse cardiac and cerebrovascular events including death, stroke, MI, and target vessel re-intervention between individuals with LM coronary artery lesion who had undergone PCI and CABG.[16] Moreover, angina relief has been reported to be more common in individuals after CABG than PCI, especially 6 months post-intervention.[12] Even in the case of drug non-compliance after either CABG or PCI, a lower prevalence of adverse events including nonfatal MI, repeated intervention, or all-cause death were observed in CABG.[17] A data analysis of 7182 individuals suffering from stable CADs suggested that despite the lack of a significant difference between PCI and MT in terms of nonfatal MI, repeated revascularization, or mortality in all follow-up durations (1 year, 1-5 years, and more than 5 years), the PCI group subjects were mostly free from angina in comparison with the MT group subjects (RR: 1.20, 95% CI: 1.06-1.37).[18]

In spite of the insignificant difference between CABG and PCI in terms of stroke incidence, data analysis of 10944 patients in the CABG and PCI groups showed that CABG was associated with higher occurrence of stroke either after a 1-month or 1-year follow-up compared to PCI (OR: 2.94, 95% CI: 1.69-5.09, P < 0.001 and OR: 1.67, 95% CI: 1.09-2.56, P = 0.020, respectively). However, the results of some studies were not in agreement with that of the present study, such as the study by Palmerini et al.[13] Their lack of consideration of stroke risk factors or variant definitions of the aforementioned diseases in different trials used for this systematic review study might have influenced the generalization of their findings.[13] Another study on 126 individuals with LM CAD duration of more than 60 years who had undergone PCI or CABG reported that the latter modality was associated with a higher prevalence of stroke and death plus HF exacerbation, but the former procedure was associated with a higher incidence rate of chest pain (P = 0.040). The non-random assignment of the therapeutic modalities might be one of the main factors influencing their findings.[9] According to a study patients who had undergone PCI experienced significantly higher health-related QOL within 6 months after revascularization compared with individuals who had undergone CABG.[19] The results of the study by Khosravi et al. indicated that patients who had undergone emergent PCI encountered more complications than patients who had undergone elective PCI.[20] Considering the higher percentage of STEMI or non-STEMI on admission in the PCI group compared with the two other therapeutic methods, some of our reported differences between the CABG and PCI groups might be attributable to the severity of complaints.

To best of our knowledge, this study was the first to compare the complications of cardiovascular events between 3 distinct treatment options in patients suffering from LM and/or 3VDs in a Middle Eastern country (Iran). The extensive pre-defined adverse events spectrum used was one of the strengths of this study. This retrospective cohort study had several limitations that should be considered. The small sample size as well as short follow-up duration might have affected our reported findings. In addition, we were not able to use the Cox models used routinely in the analysis of cohort data due to unknown occurrence date of CP and HF.

Conclusion

In conclusion, our findings revealed that it would be reasonable to recommend the CABG procedure to patients with LM and/or 3VDs due to its lower prevalence of complications including CP or HF followed by PCI rather than medical treatment alone. Several randomized controlled trials must be performed in order to confirm these associations.

Acknowledgments

This study was extracted from a fellowship dissertation that was approved by Isfahan University of Medical Sciences (No. 397682). We wish to thank all staff of the Isfahan Cardiovascular Research Center who kindly participated in our study and staff of the Public Relations Unit, and other authorities of Isfahan University of Medical Sciences for their excellent cooperation.

Conflict of Interests

Authors have no conflict of interests.

References

1. Mercado N, Wijns W, Serruys PW, Sigwart U, Flather MD, Stables RH, et al. One-year outcomes of coronary artery bypass graft surgery versus percutaneous coronary intervention with multiple stenting for multisystem disease: A meta-analysis of individual patient data from randomized clinical trials. J Thorac Cardiovasc Surg 2005; 130(2): 512-9.
2. Alaei Faradonbeh N, Nikaeen F, Akbari M, Almasi N, Vakhshoori M. Cardiovascular disease risk prediction among Iranian patients with diabetes mellitus in Isfahan Province, Iran, in 2014, by using Framingham risk score, atherosclerotic cardiovascular disease risk score, and high-sensitive C-reactive protein. ARYA Atheroscler 2018; 14(4): 163-8.
3. Mueller RL, Sanborn TA. The history of interventional cardiology: Cardiac catheterization, angioplasty, and related interventions. Am Heart J 1995; 129(1): 146-72.
4. Favaloro RG. Saphenous vein autograft replacement of severe segmental coronary artery occlusion: Operative technique. Ann Thorac Surg 1968; 5(4): 334-9.
5. Gruntzig AR, Senning A, Siegenthaler WE. Nonoperative dilatation of coronary-artery stenosis: Percutaneous transluminal coronary angioplasty. N Engl J Med 1979; 301(2): 61-8.
6. Chaitman BR, Fisher LD, Bourassa MG, Davis K, Rogers WJ, Maynard C, et al. Effect of coronary bypass surgery on survival patterns in subsets of patients with left main coronary artery disease. Report of the Collaborative Study in Coronary Artery Surgery (CASS). Am J Cardiol 1981; 48(4): 765-77.
7. Caracciolo EA, Davis KB, Sopko G, Kaiser GC, Corley SD, Schaff H, et al. Comparison of surgical and medical group survival in patients with left main equivalent coronary artery disease. Long-term CASS experience. Circulation 1995; 91(9): 2335-44.
8. Wang Z, Zhan B, Bao H, Huang X, Wu Y, Liang Q, et al. Percutaneous coronary intervention versus coronary artery bypass grafting in unprotected left main coronary artery stenosis. Am J Med Sci 2019; 357(3): 230-41.
9. Wei Z, Xie J, Wang K, Kang L, Dai Q, Bai J, et al. Comparison of percutaneous coronary intervention versus coronary artery bypass graft in aged patients with unprotected left main artery lesions. Int Heart J 2016; 57(6): 682-8.
10. Mohr FW, Morice MC, Kappetein AP, Feldman TE, Stahle E, Colombo A, et al. Coronary artery bypass graft surgery versus percutaneous coronary intervention in patients with three-vessel disease and left main coronary disease: 5-year follow-up of the randomised, clinical SYNTAX trial. Lancet 2013; 381(9867): 629-38.
11. Deo SV, Sharma V, Shah IK, Erwin PJ, Joyce LD, Park SJ. Minimally invasive direct coronary artery bypass graft surgery or percutaneous coronary intervention for proximal left anterior descending artery stenosis: A meta-analysis. Ann Thorac Surg 2014; 97(6): 2056-65.
12. Kulik A. Quality of life after coronary artery bypass graft surgery versus percutaneous coronary intervention: What do the trials tell us? Curr Opin Cardiol 2017; 32(6): 707-14.
13. Palmerini T, Biondi-Zoccai G, Reggiani LB, Sangiorgi D, Alessi L, De Servi S, et al. Risk of stroke with coronary artery bypass graft surgery compared with percutaneous coronary intervention. J Am Coll Cardiol 2012; 60(9): 798-805.
14. Kimura T, Morimoto T, Furukawa Y, Nakagawa Y, Shizuta S, Ehara N, et al. Long-term outcomes of coronary-artery bypass graft surgery versus percutaneous coronary intervention for multivessel coronary artery disease in the bare-metal stent era. Circulation 2008; 118(14 Suppl): S199-S209.
15. Neumann FJ, Sousa-Uva M, Ahlsson A, Alfonso F, Banning AP, Benedetto U, et al. 2018 ESC/EACTS Guidelines on myocardial revascularization. Eur Heart J 2019; 40(2): 87-165.
16. Capodanno D, Stone GW, Morice MC, Bass TA, Tamburino C. Percutaneous coronary intervention versus coronary artery bypass graft surgery in left main coronary artery disease: A meta-analysis of randomized clinical data. J Am Coll Cardiol 2011; 58(14): 1426-32.
17. Kurlansky P, Herbert M, Prince S, Mack M. Coronary artery bypass graft versus percutaneous coronary intervention: Meds matter: Impact of

adherence to medical therapy on comparative outcomes. Circulation 2016; 134(17): 1238-46.
18. Pursnani S, Korley F, Gopaul R, Kanade P, Chandra N, Shaw RE, et al. Percutaneous coronary intervention versus optimal medical therapy in stable coronary artery disease: A systematic review and meta-analysis of randomized clinical trials. Circ Cardiovasc Interv 2012; 5(4): 476-90.
19. Yazdani-Bakhsh R, Javanbakht M, Sadeghi M, Mashayekhi A, Ghaderi H, Rabiei K. Comparison of health-related quality of life after percutaneous coronary intervention and coronary artery bypass surgery. ARYA Atheroscler 2016; 12(3): 124-31.
20. Khosravi A, Pourmoghaddas M, Asadi K, Abdi A, Gholamrezaei A. Immediate results and six-month outcomes after percutaneous coronary intervention in a referral heart center in Isfahan, Iran. ARYA Atheroscler 2011; 7(1): 24-30.