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Comparison of Clinical Outcomes between Coronary heart Disease Patients with Complex Lesions Type Treated by Percutaneous Coronary Intervention (PCI) versus Coronary Artery Bypass Graft (CABG)

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A B S T R A C T

Background. Among the therapies, that have the greatest influence on survival of CHD patients, most were treated by percutaneous coronary intervention (PCI) and coronary artery bypass graft (CABG). There have been several studies comparing the outcomes of complex type CHD patients treated with PCI and CABG, but there are not many similar studies in Indonesia, especially at Dr. M. Djamil Hospital Padang. This study aimed to find a comparison of clinical outcomes between coronary heart disease patients with complex lesion types treated by PCI and CABG

Method. 96 patients with coronary heart disease in the, dr. M. Djamil Hospital Padang who had complex lesions (determined based on Syntax Score) on the results of Coronary Angiography from January 2022 to November 2023. Follow-up were done on clinical outcomes in-hospital and 30 days after PCI or CABG procedures on research subjects. Major adverse cardiac and cerebrovascular events (MACCE) scores including Death, Myocardial Infarction, Stroke and Repeated Revascularization, clinical symptoms, physical examination, echocardiography examination, and mortality rate.

Result. The average age of the 96 subjects was 61.77 ± 3.1 years, and 88% among them were male, and 68% subjects were diagnosed with anterior CHD. Among the subjects, 52% of them had thrombotic lesion. Overall, MACCE score showed no significant P value, which was 0.5449 between CABG and PCI patients. But, two of MACCE variables, namely reinfarction cases after the treatment were higher in PCI patient (8%) than CABG (4%), and heart failure after the treatment was higher in CABG patients (10%) compared with PCI (6%). The P values for the two variables of MACCE score were stastically significant.

Conclusion. During 6 months follow up, between PCI and CABG showed no statistically significant difference in MACCE score, but higher reinfarction were found in PCI, while heart failure percentage after the therapy was higher in CABG patients.

Keywords: Coronary Heart Disease, Percutaneous Intervension, CABG, Clinical Outcomes

1. Introduction

One of the cardiovascular diseases which is the most common cause of death in the world, is coronary heart disease. Coronary heart diseases can be defined as a condition when the coronary arteries (the arteries that supply blood and oxygen to the heart muscle) is blocked, caused by a fatty substance called 'plaque' or 'atheroma'. Plaque slowly forms on the inner walls of the arteries, causing the arteries to become narrow, which is often called atherosclerosis.[1] According to WHO data in 2015, coronary heart disease occupied the top position cause of death in middle-income countries, which is about 5.27 million per year (13.7%) and countries with high-income countries for about 1.42 million per year (15.6%). In Indonesia, the prevalence of coronary heart disease was 0.5% or an estimated 883,447 people.[2]

Research conducted by Setiawan in 2016 shows the best known survival in patient with coronary heart disease was in patients treated with the coronary bypass surgery group (CABG) (93.5%). The largest proportion of deaths occurred in the medicamentosa group (36.1%). In addition, the results of the analysis show that Percutaneous coronary intervention group (PCI) has a better survival rate than medication group (69.5% vs 63.9%). Although not statistically significant, in the PCI group, the complaints found after the procedure was smaller compared to the medical group (52% vs 38%). The Syntax score, which plays a role in assessing the complexity of stenosis, is known to determine the clinical outcome of coronary heart disease patients (p= 0.039). 5-year survival of complex type Coronary Heart Disease (CHD) patients with diabetes mellitus (DM) was best obtained in the coronary artery bypass graft (CABG) group.[3]

As the results of the research above show that among the therapies that have the greatest influence on survival of CHD patients, most were treated by percutaneous coronary intervention (PCI) and coronary artery bypass graft (CABG). PCI can be defined as a non-surgical intervention to reopen narrowed coronary arteries or blocked by inserting a balloon or stent through a catheter inserted into the lumen of the artery through a small incision in the skin.

PCI can improve symptoms in patients with unstable and stable chronic angina, as well as ST elevation myocardial infraction (STEMI). If you look at the procedure, PCI is a more advanced safe action in terms of morbidity and recovery compared to previous methods, coronary artery bypass grafting surgery (CABG). PCI in the research conducted by Weintraub (2008) has been proven to improve prognosis, reduce symptoms and reduces ischemic events because PCI is a safe medical procedure with a relatively fast recovery phase.[4]

Coronary Artery Bypass Graft (CABG) is one of the surgical intervention treatments for Coronary Heart Disease (CHD), by creating a new channel through a coronary artery that is narrowed or blocked, the new channel comes from synthetic blood vessels or blood vessels from other part of the body. Research by Elguindy in 2013 showed that CABG is recommended for patients with coronary heart disease with multivessel blockages (in many coronary blood vessels) or blockages in the left main vessel. In patients with complex coronary lesions that were treated by CABG showed a better quality of life than patients treated with PCI after 1 year follow-up based on the Major Adverse Cardiac and Cerebrovascular Events (MACCE) score. (All-cause mortality, cerebrovascular accidents, non-fatal myocardial infarction and repeat revascularization at 12 months) with a percentage of 24.2% (n = 133) vs. 37.5% (n = 205) and $p < 0.001$.[4,5]

At Dr. M. Djamil Hospital Padang as the center of coronary heart diseases treatment in Padang, PCI has been implemented for several years with a total of 1115-1200 patients per year, while CABG has just been carried out routinely only since August 2022.[6] According to Sinardja's research in 2011, it was stated that there have been several studies comparing the outcomes of complex type CHD patients treated with PCI and CABG, but there are not many similar studies in Indonesia, especially at Dr. M. Djamil Hospital Padang.[7,8] This study aimed to find a comparison of clinical outcomes between coronary heart disease patients with complex lesion types treated by PCI and CABG in several characteristics that can be used as a basis for future research. Apart from that, it can also be used as a recommendation for therapy modalities and evaluation of the successful coronary heart disease intervention at dr. M. Djamil Hospital Padang.

2. Methodology

This study used data from a cohort of patient medical records at the Department of Cardiology and Vascular Medicine at M. Djamil Hospital Padang. Data collection was carried out in a retrospective cohort by following subjects regarding events that occurred from the time the patient first experienced CHD until observation period (follow-up) which aims to find out what the early clinical outcomes of CHD sufferers who were treated with PCI and CABG and the factors that influence the outcomes. Bhisma (1997) said that cohort studies are also called follow-up or prospective studies, because the cohort is followed for a period whose development is observed. Cohort study designs can be retrospective or prospective depending on when the exposure occurred when the researcher started the research. A cohort study is retrospective if the exposure occurred before the researcher started the research. In this design the data used is secondary. Subjects are observed over a certain period of time regarding risk factors and then the effects are assessed.[9]

The research was conducted at dr. M. Djamil Hospital using secondary data from patient medical record cohort data at the Department of Cardiology and Vascular Medicine. The research will be conducted from February to December 2023. The population in this study were all patients with coronary heart disease in the Department of Cardiology and Vascular Medicine, dr. M. Djamil Hospital Padang who had complex lesions (determined based on Syntax Score) on the results of Coronary Angiography. The samples in this study were coronary heart disease patients with complex lesions from January 2022 to November 2023 who were treated with PCI or CABG. The research samples taken were patients who met the inclusion criteria in accordance with the research objectives.

The inclusion criteria in this study were patients with coronary heart disease with complex lesions as proven by a Syntax score based on the results of coronary angiography, receiving PCI or CABG therapy, and regularly coming to the Cardiology and Vascular Medicine Polyclinic, Dr. M. Djamil Hospital Padang for control/follow-up, so that the patient's medical records are complete. Research subjects who had a previous history of CABG were included in the exclusion criteria for this study. Calculation of sample size using the formula. The minimum sample size based on the Lemeshow formula is 96 cases of coronary heart disease (consisting of CHD patients treated with PCI and CABG).[7]

The research procedures were started with collecting samples by looking at register data in cardiac wards and polyclinics, then coronary heart disease patients who have complex lesions were proven by the Syntax Score from the results of coronary angiography and receive PCI or CABG therapy for the period January 1 2022 to November 30 2023. Then it was carried out by tracing data on patients in the Department of Cardiology and Vascular Medicine who underwent coronary angiography in the cardiac catheterization laboratory at Dr. M. Djamil Hospital Padang by separating patients who received PCI and CABG treatment. From this register, medical records were then traced to see the patient's CHD risk factors for adjustments. After obtaining these data, a syntax score assessment was carried out to separate data from CHD patients with complex lesions. Next, follow-up was carried out through medical records at the Heart Polyclinic to see clinical outcomes after 6 months of PCI and CABG procedures on research subjects based on Major adverse cardiac and cerebrovascular events (MACCE) scores including Death, Myocardial Infarction, Stroke and Repeated Revascularization. on the target blood vessels blockage, then clinical symptoms, physical examination, echocardiography examination, and mortality rate.[10,11]

Baseline Characteristics were expressed as means ± SD. Characteristics of subjects were analyzed using Student t tests for continuous variables and Chi-squared tests for categorical variables. Event-free survival curves were estimated by the Kaplan-Meier method. The Cox proportional hazards regression model was used to determine which variables were related significantly to MACCE. The Cox Regression steps included: The first step was to determine the candidate model variables. Candidate variables included in this analysis were variables that have a p value <0.25 in bivariate analysis. The second step is to analyze the interaction between the main variable and each candidate variable, then the results can be seen from their significance using the likelihood ratio. If the results show a p value < 0.05, it means that the interaction is included in the model, but if the p value is > 0.05, the interaction variable is not included in the Cox Regression model.[12]

3. Result

Baseline Characteristics of CHD Patients with complex coronary lesion Undergoing PCI and CABG

Table 1 explains the basic characteristics of research subjects. Based on table 1, the average age of the research subjects was 61.77 ± 3.1 years. Almost all patients (88%) were male and only a small percentage (12%) of patients were female. Cardiovascular risk factors in research subjects were smoking, diabetes mellitus, hypertension, dyslipidemia and family history of CHD. Among all risk factors, the most common study subjects were found to have dyslipidemia (73%) and smoking (58%). More than half (52.6%) of the study subjects were diagnosed with anterior CHD. Of all patients who experienced CHD with complex lesions, 23% had a family history of coronary heart disease. The subject characteristics found between the PCI and CABG groups were not significantly different. From the PCI and CABG groups, both found that the subjects' systolic and diastolic blood pressure were within normal limits.

Table 1. Baseline Characteristics of Subjects

Variables	Overall subjects	PCI Group	CABG Group
Age (years), mean ± SD	61.77 ± 3.1	62.35 ± 6.2	61.20 ± 7.2
Gender, n (%)			
Male	85 (88)	40 (83)	45 (93)
Female	11 (12)	8 (17)	3 (7)
Blood Pressure (mmHg)			
Systolic	125 ± 22.01	124 ± 21.025	126 ± 23.031
Diastolic	67	65 (50-97)	70 (50 – 97)
CHD Diagnosis, n(%)			
Anterior	66 (68)	30 (62.5)	36 (75)
Inferior	30 (32)	18 (37.5)	12 (25)
Risk Factors, n (%)			
Diabetes Melitus	31 (32)	14 (29.1)	17 (35.4)
Smoking	56 (58)	26 (54.1)	30 (62.5)
Dyslipidemia	70 (73)	33 (68.75)	37 (77)
Hypertension	47 (49)	27 (56.25)	20 (41.6)
Family History of CHD	22 (23)	12 (25)	10 (20.8)

As seen in table 2, the distribution of complex coronary lesions are shown as CTO, ostial, thrombotic, bifurcatio, classified and left main stem type of lesions. The most type of complex lesion found in research subjects was thrombotic lesion, which was lesion caused by thrombi with the percentage 52%. Ostial lesions or lesions that start within 3 mm from the origin of the main coronary artery occupy second place with a percentage of 22%. The type of complex lesion that was least common among subjects was bifucartio lesion. Bifucartio lesion is defined as stenotic lesion of a coronary artery involving the origin of a significant side branch (SB). One of the most difficult types of lesions to intervene, namely CTO or chronic thrombotic lesions, was only found in 8 percent of research subjects.

Table 2. Subject's Complex Type Lession

Complex Type Lession	n (%)
CTO	4 (8)
Ostial Lession	10 (22)
Thrombotic Lession	25 (52)
Bifucartio Lession	2 (4)
Calcified Lession	3 (6)
Left Main Stem Lession	4 (8)

Comparison of clinical outcomes between PCI versus CABG patients by MACCE Score in 6 months follow-up overall showed no statistical relationship with a P value of 0.5449. However, if we look at the respective MACCE score criteria between the PCI and CABG groups, it can be seen on Table 3 that the incidence of reinfarction after the treatment in PCI was higher than in the CABG group with a value of 0.042. In addition, the incidence of heart failure after the treatment, which is one of the variables for assessing the MACCE Score, was found to be lower in the PCI group compared to the CABG group with a P value of 0.012.

Table 3. Comparison of clinical outcomes between percutaneous coronary intervention (PCI) versus coronary artery bypass graft (CABG) by MACCE Score

MACCE Score	PCI in n (%)	CABG in n (%)	P Value
Death	1 (2)	2 (4)	0.132
Reinfarction	4 (8)	2 (4)	0.042
Stroke	0	0	N/A
Emergency Revascularization	2 (4)	1 (2)	0.211
Heart Failure	3 (6)	5 (10)	0.012
Total	11	13	0.5449

4. Discussion

This research was carried out at the Integrated Heart Center Installation of Dr. M. Djamil Hospital Padang from February 2023 to December 2023. A total of 96 patients with Coronary Heart Disease (CHD) had met the inclusion criteria. The subjects were Coronary Heart Disease (CHD) patients with complex coronary lesions and then divided into groups that were treated by PCI and by CABG. This study showed that the average age of the research subjects was 61.77 ± 3.1 years. This is in line with Bloos et al's research on 576 ACS patients, it was found that the majority (83%) of patients were over 50 years old and only a small portion (17%) of patients were under 50 years old.[13] However, based on various previous studies, there are also slight differences in terms of age. The average age at first onset of ACS in the United States is 65 years for men and 72 years for women. About two-thirds of myocardial infarctions occur in patients over 65 years of age and one-third in patients over 75 years of age. In addition, 60% of hospitalizations due to ACS occur in patients over 65 years of age.[1] Age in ACS patients is not only a risk factor, but also has prognostic significance. Age is known to be an independent risk factor for predicting the clinical outcomes of ACS patients after the procedure. In addition, older age is associated with more comorbidities and risk factors.[14]

Characteristics of research subjects based on gender in this study showed that almost all (88%) of the subjects were male. This result was in accordance with various other studies. Research conducted by Duraes et al and N'Guetta et al, found that more than 50% of STEMI patients were mostly men.[15] There are various theories that can explain this finding. The American Heart Association (AHA) states that men have a higher risk of heart attack than women. The low incidence of ACS in women is due to the protective effect of estrogen which slows the progression of atherosclerosis by influencing plaque stability and protecting it from plaque rupture. When entering menopause, women have almost the same risk of heart disease as men. Apart from that, another factor that play a role is the lifestyle of the younger generation which is characterized by work stress, overwork, smoking, drinking alcohol and overeating, which can cause disturbances in the internal organs such as coronary atherosclerosis, increasing the number of heart attacks. Alexander et al.'s study found gender differences in younger patients, such that smoking was more common in younger men than in women.[16]

Based on infarct location, more than half (52.6%) of the study subjects were diagnosed with anterior CHD. Research conducted by Obeidat et al showed that the anterior region (67%) was the most common location in myocardial infarction patients.[17] It is known that the anterior wall is the most common location with significant morbidity and mortality. The anterior wall of the heart receives blood supply through the Left Anterior Descending (LAD) Coronary artery, which supplies blood to the anterior wall of the left ventricle, the anterior part of the interventricular septum, and the anterior wall of the right ventricle. When rupture occurs in an existing atherosclerotic lesion, it leads to thrombus formation and tissue ischemia. If ischemia continues, the blood supply to the myocardium will be acutely reduced, causing myocardial necrosis.[18] This study showed that the most common risk factors for CHD with complex lesion sequentially were smoking in dyslipidemia in 70 people (73%), 56 people (58%), diabetes in 31 people (32%), and hypertension in 47 people (49%).

The most common risk factor in research subjects was dyslipidemia. This is in accordance with the pathogenesis of CHD, namely atherosclerosis. Dyslipidemia is a condition where there are abnormalities in lipid levels in the blood, including increased levels of cholesterol, LDL (Low Density Lipoprotein), and triglyceride levels, as well as decreased levels of HDL (High Density Lipoprotein). According to the latest molecular medicine research, it was found that the most dangerous type of dyslipidemia is atherogenic dyslipidemia. Atherogenic dyslipidemia LDL cholesterol deposits on the arterial walls are one of the causes of endothelial dysfunction as an initial process for the formation of atherosclerotic plaque.

There are various explanations for these findings. Research by Aminuddin et al in 2023 showed that atherosclerosis is related to the innate immune response and is characterized by a chronic inflammatory process in the walls of blood vessels. Various studies show that in ACS patients, smoking is the most common risk factor found. Smoking is known to increase vascular disease by causing blood vessel inflammation and oxidative stress. Exposure to cigarette smoke can cause excessive matrix metalloproteinase (MMP) activity and inflammation. Increased MMP activity is responsible for activated and

unstable plaques in Acute Myocardial Infarction.[19] This theory is in line with this research, it was found that the one of common risk factor was smoking with 56 people (58%).

The other risk factor of CHD with complex coronary lesions in this study was family history (23%). The 10-year risk of CHD was disclosed by a genetic counselor informing participants of a 1.5- to 2.0-fold higher risk in the presence of family history, followed by shared decision making regarding statin therapy with a physician. This was stated by Shoulifah (2016) in his research, that there was a significant relationship between family history with CHD incidents at RSUD Dr. Kanudjoso Djatiwiowo Balikpapan with The Odd Ratio (OR) is 12.273, which means respondents who have a family history suffering from CHD has a risk of suffering from CHD as much as 12,273 times compared to respondents who have no family history of CHD.[20]

On the other hand, there was not much research about the types of complex lesions in coronary heart disease, so it needs further study. A short explanation of some of the most common complex lesions, namely bifurcation lesions: these arise at or adjacent to the separation of a major coronary artery. They occur when the main coronary arteries divide into two smaller anatomic portions. Second is calcified lesions: Vascular calcification of the coronary arteries is a common process actively regulated and involves atherosclerotic, inflammatory, and hormonal disease processes. Coronary artery calcification (CAC) involves intimal and medial calcification. Third type is chronic total occlusions (CTO), a complete obstruction of a coronary artery. The fourth one is Left main coronary artery (LMCA) disease: Left main coronary artery disease can be problematic given that it is the origin of the majority of the left ventricular coronary supply. The fifth one is ostial lesion: An ostial lesion starts within 3 mm of the origin of a major coronary artery. These may be challenging to stent due to proximity to the aorta.[21,22]

The last one is thrombotic lesion, which is lesion caused by multiple thrombi (however not total occlusion). In this study, the least common lesions were bifurcation lessions (4%). However, the study by Syed (2024) did not mention the same. Coronary bifurcation and CTO lesions are the most common of the complex coronary lesions. Some estimates have reported that these are found in up to 20% of all PCI each. According to Syed (2024), CTOs are found in 47% of individuals who present with acute coronary syndrome and in 89% of individuals with prior coronary artery bypass grafting (CABG). The most common type of complex coronary lesions found on the study was thrombotic lesions as much as 52 %. Each complex coronary artery lesion has a unique set of etiologies. Complex coronary lesions carry higher overall mortality in patients with stable angina than those with noncomplex lesions. These complex lesions are often associated with diabetes, lower ventricular ejection fraction, and lower HDL-C. In general, the angiography results of coronary heart disease patients (both emergency and elective cases) at M. Djamil Hospital are indeed the highest in thrombotic lesions with a prevalence of 35% compared to other types of lesions.[21]

MACCE score was not significantly different between PCI vs CABG which is in line with Jajang, et al study. Th result of this article can be insignificant caused by the short period of follow-up which was only 6 months after PCI and CABG. This could be the limitation of this study. Further study was needed to follow-up the MACCE score or other outcomes of PCI and CABG to get more reliable and representative comparation. [5]

However, two of MACCE score criterias, namely reinfarction cases after the treatment were higher in PCI patient (8%) than CABG (4%), and heart failure after the treatment was higher in CABG patients (10%) compared with PCI (6%). The P values for the two criterias of MACCE score were stastically significant. Coronary artery disease is the most common cause of heart failure (HF). Based on study by Magnus, et al. (2016), in patients undergoing coronary artery bypass grafting (CABG), HF with reduced ejection fraction (HFrEF) is known to be associated with poor short-term and long-term prognosis. CABG therapy is associated with larger vessels thrombosis, more comorbidities, and more complications. This study is in line with this article that heart failure cases after CABG is higher than after PCI. Stroke due to thrombus post-operative.[5]

On the other hand, reinfarction most likely to happen after PCI (P value 0.042) because stent thrombosis that happen in PCI. Stent thrombosis could happen because of several reasons such as human error, lack of advance imaging devices and etc. In connection with the higher incidence of reinfarction and repeat revascularization found in post-PCI patients compared to CABG, this is in accordance with the results of research by Yoga Yuniadi in 2015 where cases of repeat myocardial infarction and repeat revascularization were found to be 1.9% and 7.2% higher respectively in PCI patients than CABG. Unlike PCI, CABG replaces new graft vessel into problematic vessels, so that the reinfarction is rarely happened.[5,21]

5. Conclusion

During six months follow up after treatment, between PCI and CABG showed no statistically significant difference in MACCE score. On the other hand, there was higher reinfarction percentage in PCI, while heart failure percentage after the therapy was higher in CABG patients.

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