



POST-OPERATIVE OUTCOMES DIFFERENCE BETWEEN ON-PUMP AND OFF-PUMP CORONARY-ARTERY BYPASS GRAFTING (CABG) SURGERY OVER 60 YEARS OLD PATIENTS AT H. ADAM MALIK GENERAL HOSPITAL MEDAN

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Abstract

Background: The high incidence of coronary heart disease led to an increase in the number of Coronary-Artery Bypass Grafting (CABG) surgeries, recorded over 340,000 CABG actions performed in the U.S. with 82.4% using on-pump techniques and 17.6% using off pump techniques. Patients with contraindications to on-pump CABG, such as patients with calcified aorta, advanced age, and significant comorbidity, may be candidates for off-pump CABG. **Objectives:** This study aims to see outcomes difference between patients that performed off-pump CABG technique compared to on-pump CABG technique at H. Adam Malik General Hospital Medan period 2015-2019.

Methods: This research is an analytical research with retrospective case-control design conducted in coronary heart disease patients aged 60 years and above with indications of CABG in 2017 to 2019 who underwent surgery in the Division of Cardio-Thoracic Surgery, Surgery Department of The Faculty of Medicine, Universitas Sumatera Utara – H. Adam Malik General Hospital Medan. Samples in this study will be taken consecutively of 88 subjects.

Results: Based on the study subjects, the average age of patients underwent on-pump CABG was 64.55 (\pm 3.61) years old, while the average age of patients underwent off-pump CABG was 64.82 (\pm 4.70) years. From length of stay in ward or ICU, length of ventilator use, inotropic use, incidence of surgical wound infection, incidence of kidney failure, incidence of stroke, myocardial infarction, PRC and FFP transfusion needs, as well as mortality in patients, found there is no significant difference with p value $>$ 0.05 in two groups.

Conclusion: There is no post-operative outcomes difference between between on-pump and off-pump CABG Surgery

Keywords: coronary heart disease, CABG, on-pump, off-pump

I. INTRODUCTION

The high incidence of Coronary Heart Disease (CHD) has led to an increase in the number of coronary-artery bypass grafting (CABG) operations, with more than 340,000 CABG procedures performed in the US with 82.4% using the on-pump technique and 17.6% using the off pump (AHA) technique. (, 2018). The death rate caused by CHD in Indonesia is quite high, reaching 1.25 million if Indonesia's population is 250 million (Ministry of Health, 2014). An increase in the number of CABG operations was also found in Indonesia. In the 2017 Ginting study, it was reported that 92 CABG operations were performed at the H. Adam Malik General Hospital in Medan during the 2015 to 2016 period with the proportion of patients over 65 years of age of 15.7% (Ginting, 2017).

Coronary-artery bypass grafting (CABG) is a procedure in which an autologous artery or vein is used as a graft to replace a coronary artery that is partially or completely blocked by atherosclerotic plaque (Alexander, Smith, 2016). On-pump CABG performed at cardiopulmonary bypass is one of the most commonly performed procedures and an excellent treatment for ischemic heart disease. (Houliand et al., 2012). Patients with contraindications for on-pump CABG, such as patients with calcified aorta, advanced age, and significant comorbidities, may be candidates for off-pump CABG.

Differences in postoperative atrial fibrillation, blood transfusions, release of biochemical markers of myocardial damage, and length of stay appear to support the selection of the off-pump technique. On the other hand, several studies have shown that patients undergoing off-pump have a greater risk of partial revascularization and graft failure, than patients undergoing on-pump CABG. (Houliand et al., 2012). A large study comparing off-pump CABG with on-pump surgery (CORONARY study) did not show a significant difference in survival after five years. Several studies have questioned the advantages of off-pump over on-pump operation with some of them showing better survival. However, all of them show that the results are biased with (<20 cases in the Randomized On / Off Bypass (ROOBY) study (Matkovic et al., 2019).

Meanwhile, research by Zhao et al looking at how cost-effective measures were shown that the mean cost of initial hospitalization was significantly less in the off-pump group than in the on-pump group (\$ 11,744 compared to \$ 13,720, P <0.001). Meanwhile, the average cost of length of stay was \$ 6,669 for the off-pump group, compared to \$ 8,031 for the on-pump group (P <0.001). There was also a significant difference in the mean cost of needed blood transfusion bags between the two off-pump and on-pump groups (\$ 28 compared to \$ 79, P <0.001).

From the description above, it can be seen that there are several differences in the output data between patients who underwent surgery with the off-pump CABG technique compared to on-pump CABG. In addition, this type of research has never been carried out before, especially in North Sumatra. Based on this, the researchers are interested in examining the differences in outcome data between patients who underwent surgery with the CABG off-pump technique compared to on-pump CABG at H. Adam Malik General Hospital in Medan for the period 2015-2019.

II. METHODS

This study is an analytical study with a retrospective case-control study design conducted on CHD patients 60 years and over with CABG indication from 2017 to 2019 who underwent surgery in the Thoracic Cardio Vascular Surgery Division, Department of Surgery, Faculty of Medicine, University of North Sumatra - RSUP . H. Adam Malik Medan. The sample in this study will be taken by consecutive sampling and based on the formula, the sample size obtained in this study is 88 subjects.

The inclusion criteria in this study were patients who came to the surgery department at RSUP H. Adam Malik Medan and underwent CABG surgery either on-pump or off-pump; patient age over 60 years; and subjects could be followed for 30 days after CABG surgery. While the exclusion criteria of this study were subjects with CHD accompanied by heart valve disease, subjects with a history of previous hemodialysis, subjects who were not completely revascularized, subjects left the operating room with extracorporeal life support devices and the subject died on the operating table. Researchers conducted research on the medical records of patients who underwent on-pump and off-pump CABG. Then performed data recording on medical records related to demographics, morbidity, and mortality of patients.

III. RESULTS

Based on the sample calculation formula, 88 patients were sampled in this study. The mean age of patients undergoing CABG on-pump was 64.55 (\pm 3.61) years, while the mean age of patients undergoing CABG off-pump was 64.82 (\pm 4.70) years. A total of 32 (72.73%) patients who underwent CABG on-pump were male and 12 (27.27%) were female, while in the group of patients who underwent CABG off-pump as many as 33 (75.00 %) male patients and 11 (25.00%) female patients. Demographic data for the sample of this study are presented in Table 1.

Table 1. Demographic Characteristics

	CABG On-pump	CABG Off-pump
Age (years) (mean \pm SD)	64,55 (\pm 3,61)	64,82 (\pm 4,70)
Male gender	32 (72,73%)	33 (75,00%)
Smoking (patient)	40 (97,56%)	38 (92,86%)
Diabetes Mellitus (patient)	35 (85,36%)	37 (90,24%)
Other co-morbid (patient)	27 (65,85%)	35 (85,36%)
Family History (patient)	39 (95,12%)	36 (87,80%)
CHD severity (patient)	35 (85,36%)	28 (68,29%)

Based on statistical tests on the length of stay of patients over 60 years of age after on-pump and off-pump CABG surgery, there was no statistically significant difference. In patients who had CABG on-pump, the average length of stay was 14.89 (\pm 6.12) days, while in patients who had CABG off-pump, the average length of stay was 16.02 (\pm 5.81) days presented in the Table 2.

Table 2. Average length of stay of patients more than 60 years of age after on-pump and off-pump CABG surgery

	Mean length of stay (\pm SD)	p-value
CABG on-pump	14,89 (\pm 6,12) days	0,374 ^a
CABG off-pump	16,02 (\pm 5,81) days	

^aIndependent T-test (p value <0.05 is considered significant)

In Table 3, data related to the ICU stay of patients aged more than 60 years after on-pump and off-pump CABG surgery are presented based on statistical tests, and there is no statistically significant difference. In patients who were given CABG on-pump, the average length of stay was 6.43 (\pm 3.55) days, while in patients who had CABG off-pump, the average length of stay was 6.39 (\pm 3.45) days.

Table 3. Average ICU length of stay for patients more than 60 years of age after on-pump and off-pump CABG

	ICU length of stay (\pm SD)	p-value
CABG on-pump	6,43 (\pm 3,55) days	0,952 ^a
CABG off-pump	6,39 (\pm 3,45) days	

^aIndependent T-test (p value <0.05 is considered significant)

In the comparison of the length of use of the ventilator in patients aged more than 60 years after on-pump and off-pump CABG surgery, there was no statistically significant difference. In patients who were given CABG on-pump, the average length of stay was 3.16 (\pm 2.01) days, while in patients who had CABG off-pump, the average length of stay was 3.48 (\pm 2.18) days. which is presented in table 4.

Table 4. Average duration of use of patient ventilators more than 60 years of age after on-pump and off-pump CABG surgery

	Average length of ventilator use (\pm SD)	p-value
CABG on-pump	3,16 (\pm 2,01) days	0,479 ^a
CABG off-pump	3,48 (\pm 2,18) days	

^aIndependent T-test (p value <0.05 is considered significant)

Regarding the use of inotropic therapy in patients over 60 years of age after on-pump and off-pump CABG surgery, there was no statistically significant difference. In patients who underwent on-pump CABG, it was found that 41 (93.18%) patients used inotropic therapy and 3 (6.81%) patients did not use postoperative inotropic therapy, while in patients who received off-pump CABG, it was found that 42 (95.45%) patients used inotropic therapy and 2 (4.55%) patients did not use postoperative inotropic therapy, which can be observed in Table 5.

Table 5. Inotropic Use in patient over 60 years of age after on-pump and off-pump CABG surgery

	Inotropic use after surgery		p-value
	With inotropic	Without inotropic	
CABG on-pump	41(93,18%)	3 (6,81%)	0,645 ^a
CABG off-pump	42 (95,45%)	2 (4,55%)	

^aChi-square test (p value <0.05 is considered significant)

Table 6 presents statistical tests related to the incidence of surgical wound infection in patients aged more than 60 years after on-pump and off-pump CABG surgery, there were no statistically significant differences. In patients who underwent on-pump CABG, it was found that 6 (13.64%) patients had surgical wound infections and as many as 38 (86.36%) patients did not experience surgical wound infections, while in patients who had CABG off-pump, there were 4 (9.09%) patients experienced surgical wound infection and as many as 40 (86.36%) patients did not experience surgical wound infection.

Table 6. Incidence of Patient Surgical Wound Infection more than 60 years of age after on-pump and off-pump CABG surgery

	Incidence of Surgical Wound Infection		p-value
	Wound infection present	Wound infection absent	
CABG on-pump	6 (13,64%)	38 (86,36%)	0,502 ^a
CABG off-pump	4 (9,09%)	40 (86,36%)	

^aChi-square test (p value <0.05 is considered significant)

Based on statistical tests on the incidence of renal failure in patients aged more than 60 years after on-pump and off-pump CABG surgery, there was no statistically significant difference. In patients who underwent on-pump CABG, it was found that 10 (22.73%) patients had kidney failure and 34 (77.27%) patients did not experience kidney failure, while in patients who had CABG off-pump, there were 5 (11.36%) patients had kidney failure and 39 (88.64%) patients did not experience kidney failure which is in the table 7.

Table 7. Renal Failure in Patients more than 60 years of age after on-pump and off-pump CABG surgery

	Kidney Failure incidence		p-value
	Kidney failure present	Kidney failure absent	
CABG on-pump	10 (22,73%)	34 (77,27%)	0,156 ^a
CABG off-pump	5 (11,36%)	39 (88,64%)	

^aChi-square test (p value <0.05 is considered significant)

Table 8 shows the results of statistical tests on the incidence of stroke in patients aged more than 60 years after on-pump and off-pump CABG surgery, there was no statistically significant difference. In patients who underwent on-pump CABG, it was found that 3 (6.82%) patients had a stroke and as many as 41 (93.18%) patients did not experience a stroke, while in patients who had CABG off-pump, there were 1 (2.27%) patients had a stroke and as many as 43 (97.73%) patients did not have a stroke.

Table 8. Incidence of Stroke in Patients more than 60 years of age after on-pump and off-pump CABG surgery

	Stroke incidence		p-value
	Stroke present	Stroke absent	
CABG on-pump	3 (6,82%)	41 (93,18%)	0,306 ^a
CABG off-pump	1 (2,27%)	43 (97,73%)	

^aChi-square test (p value <0.05 is considered significant)

Based on statistical tests on the incidence of myocardial infarction in patients aged more than 60 years after on-pump and off-pump CABG surgery, there was no statistically significant difference. In patients who underwent on-pump CABG, it was found that 16 (36.36%) patients had myocardial infarction and as many as 28 (63.64%) patients did not have myocardial infarction, while in patients who had CABG off-pump, there were 18 (40.91%) patients had myocardial infarction and 26 (59.09%) patients did not experience myocardial infarction and are presented in Table 9.

Table 9. Incidence of myocardial infarction in more than 60 years of age after on-pump and off-pump CABG surgery

	Myocardial Infarction incidence		p-value
	Myocardial infarction present	Myocardial infarction absent	
CABG on-pump	16 (36,36%)	28 (63,64%)	0,661 ^a
CABG off-pump	18 (40,91%)	26 (59,09%)	

^aChi-square test (p value <0.05 is considered significant)

Based on statistical tests on the need for blood transfusions in patients aged more than 60 years after on-pump and off-pump CABG surgery, there was no statistically significant difference. In patients who underwent on-pump CABG, the average postoperative blood transfusion requirement was 680.75 ± 173.25 mL of PRC and 462.5 ± 452.5 mL of FFP, whereas in patients who received off-pump CABG it was -The mean postoperative blood transfusion requirement was 691.25 ± 178.5 mL PRC and 425.0 ± 412.5 mL FFP postoperatively which can be observed in Table 10 and Table 11.

Table 10. Average PRC Transfusion Requirements based on CABG on-pump and off-pump operation techniques

	Average PRC Transfusion Requirements (±SD)	p-value
CABG on-pump	680,75 ± 173,25 mL	0,772 ^a
CABG off-pump	691,25 ± 178,5 mL	

^aT test (p value <0.05 is considered significant)

Table 11. Average FFP Transfusion Requirements based on CABG on-pump and off-pump operation techniques

	Average FFP Transfusion Requirements (±SD)	p-value
CABG on-pump	462,5 ± 452,5 mL	0,685 ^a
CABG off-pump	425,0 ± 412,5 mL	

^aT test (p value <0.05 is considered significant)

Based on statistical tests of mortality in patients over 60 years of age after on-pump and off-pump CABG surgery, there was no statistically significant difference. In patients who underwent on-pump CABG, it was found that 7 (15.90%) patients died and as many as 37 (84.10%) patients lived postoperatively, while in patients who had CABG off-pump, there were 2 (4.54%) patients died and 42 (95.45%) patients lived postoperatively which are presented in the Table 12.

Table 12. Mortality in Patients more than 60 years of age after on-pump and off-pump CABG surgery

	Mortality		p-value
	Death	Alive	
CABG on-pump	7(15,90%)	37 (84,10%)	0,07 ^a
CABG off-pump	2 (4,54%)	42 (95,45%)	

^aChi-square test (p value <0.05 is considered significant)

IV. DISCUSSION

This study was conducted on patients who underwent CABG aged ≥ 60 years. The risk of postoperative complications is found to increase with CABG surgery with advancing age. Several other studies have been conducted to assess the outcome of CABG surgery in the elderly using on-pump and off-pump techniques. The differences in age standards were obtained as inclusion criteria regarding the definition of elderly. In this case the researchers followed WHO guidelines in determining elderly, namely age ≥ 60 years. Other researchers such as the Brazilian study by Pricilia Aikawa et al used the age benchmark ≥ 65 years, while another study in Brazil by Rocha et al used the age benchmark ≥ 70 years considering that the increased risk of sepsis and hemostatic disorders was more significant in that age group.

Houllind et al's study used a benchmark age ≥ 70 years in an RCT study of 900 patients with consideration of increasing life expectancy in developed countries accompanied by several studies that stated this age group was a moderate to severe risk group. Another study in Turkey also used an age benchmark ≥ 70 years in analyzing differences in postoperative outcomes for on-pump and off-pump CABG. Age-related changes occur in systemic vessels, namely changes in vascular morphology and function, and arterial wall thickening, mainly due to changes in matrix walls, increased elastolytic and collagenolytic activity, and changes in vascular smooth muscle.

Changes in the heart are associated with many ionic, molecular, and biochemical changes in the heart that affect protein function, mitochondrial oxidative phosphorylation, contraction, calcium kinetics, myofilament activation, matrix composition and regeneration, cell growth and size, and the process of apoptosis. Changes in the coronary circulation, the presence of cardiovascular disease and weakness of the heart muscle increase the risk of complications after CABG surgery (Nicolini, Agostinelli, Vezzani, et al; 2014).

The mean age of patients in this study was $64.55 (\pm 3.61)$ years in the group of patients who underwent surgery with the on-pump technique and $64.82 (\pm 4.70)$ years in the group of patients who had the off-pump technique. A study of CABG outcomes with on-pump and off-pump techniques by Matkovic et al without age benchmarks found that the mean age of patients who underwent on-pump CABG was 63.8 ± 8.7 years and in the CABG off-pump group was $63, 4 \pm 8.2$ years. Other studies have varied mean age which is influenced by the age benchmark in determining grouping of samples.

Male gender as one of the unmodifiable risk factors in patients with coronary heart disease according to the results of this study in both the on-pump and off-pump groups was 72.73% and 75.00%, respectively. The presence of estrogen in premenopausal women is theoretically a protective factor that delays coronary heart disease. In Knowlton's study, it was stated that estrogen receptors play a role in the remodeling process and prevention of inflammation of the cardiovascular system. Estrogen therapy has a protective effect against apoptosis and necrosis of heart and endothelial cells (Knowlton, Lee; 2012).

In this study, there were no significant differences in ICU length of stay in the two groups in the off-pump and on-pump groups, namely $6.39 (\pm 3.45)$ and $6.43 (\pm 3.55)$ days, respectively. In a 2013 study that took a population aged 70 years or more in Iran, it was found that an average length of stay in the ICU was 2.5 ± 0.6 days in the off-pump group and 3.6 ± 1.8 days in the on-pump group which were statistically significant (Mirhosseini, Forouzannia, Hassan-Sayegh, et al; 2013). Anno Diegeler et al's study found that an average length of stay in the ICU was 3.7 days in the off pump group and 4.3 days in the on-pump group which was not statistically significant (Diegeler, Börgermann, Kappert, et al, 2013). The Acta Chirurgica Belgica study published insignificant mean ICU length of stay in the on-pump and off-pump groups of 35.8 ± 38.7 hours and 41.2 ± 46.3 hours, respectively. The differences in some of these studies can be caused by differences in age group benchmarks, as well as other factors that can affect post-CABG outcomes (Yuksel, Yolgosteren, Irem Kan, et al; 2017).

In the observation of the length of time using the ventilator, it was found that in the on-pump group the mean time of using the ventilator was $3.16 (\pm 2.01)$ days, while in the off-pump group the mean time of using the ventilator was $3.48 (\pm 2, 18)$ days which were not statistically significant. Other studies also found a difference that was not statistically significant with results of 25.1 hours in the off-pump group and 30.7 hours in the on-pump group (Diegeler, Börgermann, Kappert, et al, 2013). However, a study in Belgium found significant differences between the two groups in the period of postoperative ventilator use with the sample group aged 70 years or more (Yuksel, Yolgosteren, Irem Kan, et al; 2017).

In the observation of the use of post-CABG inotropes, it was found that 41 (93.18%) patients in the CABG on-pump group used inotropic therapy, while 42 (95.45%) patients who were given CABG off-pump used inotropic statistically significant. Masoumi et al obtained different results in the observation of the two groups with the inclusion criteria of patients with low ejection fraction ($\leq 35\%$), in the off-pump group less in terms of inotropic use (Masoumi, Saidi, Rostami, et al; 2008). In other literature, there were no statistically significant differences in the use of postoperative inotropes as in the publication of Houllind et al. In a multicentre study involving 900 patients (Houllind, Kjeldsen, Madsen, et al; 2012).

In observing the incidence of surgical wound infection, as many as 6 (13.64%) patients had surgical wound infections in the on-pump group while 4 (9.09%) patients had surgical wound infections in patients who had off-pump CABG who did not. statistically significant. In the Mirhosseini study in Iran, there was a significant difference in the incidence of surgical wound infection in the two populations, there was less incidence of surgical wound infection in the off-pump group with the description in the on-pump group as many as 8 (20%) patients experienced surgical wound infection, while in the group Off-pump was found that 2 (5%) patients had surgical wound infections (Mirhosseini, Forouzannia, Hassan-Sayegh, et al; 2013). The incidence of surgical wound infection does not only depend on the CABG surgical technique, but can be influenced by other risk factors such as diabetes mellitus or post-CABG wound care. Legare et al. Have published a study of 150 patients in each group with significantly less incidence of surgical wound infection and even postoperative sternal osteomyelitis in the off-pump group (Légaré, Buth, King, et al; 2004). Shahzad's study in London, England in 2015 with a meta-analysis design involving 8 publications found that significant differences in the incidence of surgical wound infection were less common in the off-pump group (Shahzad, 2015).

In the observation of the incidence of post-CABG renal failure, there were 10 (22.73%) patients undergoing CABG on-pump patients experiencing kidney failure and 5 (11.36%) patients who had CABG off-pump. had renal failure, but the results were not statistically significant. A German study comparing the two CABG techniques to the incidence of post-CABG renal failure involving 2539 patients found 29 (2.4%) patients in the off-pump group and 37 (3.1%) patients in the on-pump group experienced postoperative renal failure at 30 days of follow-up. first postoperatively, at 12 months postoperative follow-up there was still no statistical difference in the incidence (Diegeler, Börgermann, Kappert, et al, 2013).

In observing the incidence of stroke after CABG surgery, in the group of patients who underwent on-pump CABG, there were 3 (6.82%) patients who had a stroke, while in patients who were given CABG off-pump, only 1 (2.27%) patient had a stroke, but this was not statistically significant. A study by Dheeraj et al in India of 581 patients found the incidence of stroke in the off pump and on pump groups, respectively, 2.1% and 2.6% at follow-up for 30 days postoperatively which was not statistically significant (Dheeraj, Sisodia, Devgarha, et al; 2016). In another study, it was found that 1.5% and 3.9% of patients after CABG surgery with off-pump and on-pump techniques experienced strokes, these results were not statistically significant (Yuksel, Yolgosteren, Irem Kan, et al; 2017).

Stroke in some people is considered a complication that is worse than death. The stroke rates in patients undergoing CABG were no different. Puskas et al. reviewed stroke incidence in 10,860 patients undergoing CABG, showing that age by decade (OR 1.9; 95% CI, p value <0.001) is an independent risk factor for stroke as well as transient ischemic attacks and the presence of carotid bruits (Puskas, Gaudino, Taggart, et al; 2019). In monitoring the incidence of myocardial infarction after CABG surgery, in patients who underwent on-pump CABG, it was found that 16 (36.36%) patients had myocardial infarction and 28 (63.64%) patients did not experience myocardial infarction, whereas in patients who had myocardial infarction. performed off-pump CABG, it was found that 18 (40.91%) patients had myocardial infarction and 26 (59.09%) patients did not experience myocardial infarction. In a study in Denmark by The Danish On-pump Off-pump Randomization Study (DOORS), 4.1% of on-pump patients and 2.0% of off-pump patients experienced postoperative myocardial infarction. The overall number of myocardial infarction was higher in our study than any other study. This difference may be due to closer monitoring of the ECG and biochemical markers of myocardial damage (Houllind, Kjeldsen, Madsen, et al; 2012).

The elderly population is particularly susceptible to damage by inflammatory mediators. In several publications it is mentioned that off-pump is associated with a reduction in the risk of stroke, decreased neurocognitive function, delirium, atrial fibrillation, and acute renal impairment risks faced in this population. In addition, the off-pump approach reduces the need for transfusions and the use of postoperative inotropes as well as the time spent on ventilation, intensive care units and length of stay in the hospital. Improvements in surgical and anesthetic techniques decreased the incidence of persistent stroke associated with CABG from 1% to 5% of patients (Nicolini, Agostinelli, Vezzani, et al; 2014)

In the analysis of the incidence of post-CABG mortality, it was found that 7 (15.90%) patients who had CABG on-pump had died postoperatively, whereas in patients who had CABG off-pump, there were 2 (4.54%) patients. died postoperatively, but these results were not statistically significant. Research in Iran showed that there were 7.5% postoperative mortality in the on-pump group and 5% in the off-pump group, but this was not statistically significant (Masoumi, Saidi, Rostami, et al; 2008).

Off-pump CABG has the potential to reduce some of the side effects of on-pump CABG due to not using a cardiopulmonary bypass machine (CPB), the harmful effects of cardioplegia, stopping coronary blood flow, and excessive manipulation of the aorta. However, the risk of hemodynamic instability during surgery and causing incomplete revascularization especially in the hands of inexperienced surgeons is a major limitation of off-pump CABG (Yuksel, Yulgosteren, Irem Kan, et al; 2017).

The limitation of our study is that it is based on information obtained from retrospective medical records. Then observations were only made during the first 30 days of post-CABG treatment. Then no observations were made to differentiate between cardiac and noncardiac causes of death because of the difficulty in determining the cause of death in the elderly patient population. There can be bias given events such as myocardial infarction and possible recurrent revascularization, which would affect both groups. Furthermore, no observations were made on patient risk, especially using a standardized and widely used scoring system such as Euroscore in determining patient risk before surgery. Another limitation is the absence of specific monitoring of graft count, graft damage and repeated revascularization measures in post-CABG patients. Moreover, in this study only two characteristics were considered, namely CABG off-pump and on-pump.

V. CONCLUSION

The high incidence of CHD has led to an increase in the number of Coronary-artery bypass grafting (CABG) operations, with over 340,000 CABG procedures performed in the US with 82.4% using the on-pump technique and 17.6% using the off pump technique. Coronary-artery bypass grafting (CABG) is a procedure in which an autologous artery or vein is used as a graft to replace a coronary artery that is partially or completely blocked by atherosclerotic plaque. On-pump CABG performed on cardiopulmonary bypass is one of the most commonly performed procedures and an excellent treatment for ischemic heart disease considering the fact that opulent elderly are highly susceptible to damage by inflammatory mediators. The conclusion of this study was that there were no differences in post-CABG surgery outcomes performed by on-pump and off-pump techniques ($p > 0.05$).

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