

Comparison of Postoperative Renal Function Test between Off-pump Coronary Artery Bypass Grafting and On-pump Coronary Artery Bypass Grafting in 10 Years in Haji Adam Malik Hospital Medan

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Abstract: To analyze the difference between the results of the examination of renal function before and after the on-pump CABG (CABG) action compared to the off-pump CABG (OPCAB) action for 10 years. A cross-sectional study using medical record evaluated the ureum, creatinine, and creatinine clearance between OPCAB and CABG. This was also followed by urea differences after the procedure of either CABG or OPCAB with a p-value of 0.049. There was no statistically significant difference at the time after the procedure, where the result of the p-value obtained was 0.187. When viewed from the median value, the creatinine value in the CABG group is 0.82 compared to the OPCAB group of 0.89. While the last variable assessed was CrCl, after the procedure, the value of p = 0.926 is obtained. However, when viewed at the median OPCAB value is 89 compared to CABG which is 86.81. Coronary artery bypass grafting procedures with either the on-pump or off-pump method only minimally affect kidney function. The different procedures also do not differ from each other against creatinine clearance and also serum creatinine. However, there are differences in urea levels.

1 INTRODUCTION

CABG is one of the main surgical procedures most often performed, approximately 400,000 operations performed annually in the United States. However, over the past decade, there has been almost a 30% reduction in CABG procedures in the United States, despite an aging population and increasing evidence to support the effectiveness and safety of operations. This decrease was accompanied by an increase in percutaneous coronary revascularization procedures (Alexander & Smith, 2016).

Off-pump coronary artery bypass grafting (OPCAB) is a surgical technique for coronary revascularization that eliminates the use of a cardiac pulmonary bypass (CPB) machine in managing ischemic heart disease. On-pump Cardiac arrest CABG has been the gold standard in CABG for a long time, however, off-pump CABG (OPCAB) has been developed along with advancements in the device to avoid the damaging effects of the extracorporeal circulation.

Renal dysfunction is a major complication that is well known after CABG. Reported incidents vary with the criteria used, ranging from 1% to almost 40%. Plasma creatinine levels are very specific markers of kidney function. Plasma creatinine levels are easily obtained but depend on the patient's muscle mass. The relationship between preoperative renal dysfunction and postoperative morbidity and mortality is stronger when creatinine clearance (CrCl) is used than the creatinine level used. Several authors have reported the beneficial effects of OPCAB in high-risk patients in terms of prevention of potential ARF. Based on these findings, this study aimed to analyze the difference between the results of the examination of renal function before and after the CABG action compared to the OPCAB action for 10 years.

2 METHODS

A cross-sectional study was performed based on secondary data from the medical record in Haji Adam Malik General Hospital, Medan from January 2019 to March 2019. Age between 20 to 60 years old who underwent coronary artery bypass grafting in Cardiothoracic Surgery Department in Haji Adam Malik General Hospital from January 2009 to December 2018, having ureum less than or equal to 40 mg/dL and creatinine less than or equal to 1,1 mg/dL were the inclusion criteria in this study, while previous history of chronic renal failure and incomplete medical record were the exclusion criteria. The ureum, creatinine, and creatinine clearance were measured twice, preoperative and postoperative. Normally distributed data were presented in mean (\pm SD) and non-normal data distribution were presented in median (min-max) and nominal data in frequency (%). Analysis using the Wilcoxon test was used to analyze the pre- and postoperative renal function and Mann-Whitney test to compare the CABG to OPCAB procedure. Statistical analyses were made using SPSS version 23.0.

3 RESULTS

Patients characteristics were presented in table 1.

Table 1. Patients characteristics

Characteristics	CABG	OPCAB
Age (mean \pm SD)	52.10 \pm 5.22	52.30 \pm 6.28
Gender		
Male (n, %)	72 (87.8)	34 (85.0)
Female (n, %)	10 (12.2)	6 (15.0)
Body Weight	63.5 \pm 13.9	66.28 \pm 12.5

Table 2. Renal function before and after CABG

Characteristics	Before CABG	After CABG	p-value ⁺
Ureum	23.95 (11.0-39.8)	39.00 (17.0-71.0)	0.0001*
Creatinine	0.83 (0.49-1.08)	0.82 (0.40-1.15)	0.052
Creatinine Clearance	93.06 (38.28-184.53)	86.81 (39.06-175.00)	0.106

⁺Statistical analyses were performed using the Wilcoxon test

*Statistical significant was found in p-value <0.05

In table 2, based on the characteristics of patients who underwent the CABG procedure, for ureum before CABG, the median was 23.95 with a minimum value of 11.0 and the highest value was 39.8. Whereas after CABG, the median value is 39.0 with a minimum of 17.0 and a maximum of 71.0. The statistical test results show significance with a value of p = 0.0001. While other variables did not show any differences.

Table 3. Renal function before and after OPCAB

Characteristics	Before OPCAB	After OPCAB	p-value ⁺
Ureum	26.0 (12.9-90.0)	32.5 (15.0-86.0)	0.016*
Creatinine	0.93 (0.57-1.10)	0.88 (0.38-1.11)	0.061
Creatinine Clearance	85.96 (34.81-162.44)	89.00 (40.49-215.50)	0.060

⁺Statistical analyses were performed using the Wilcoxon test

*Statistical significant was found in p-value <0.05

Based on table 3, the characteristics of patients who underwent the OPCAB procedure, for ureum before OPCAB, the median was 26.0 with the minimum value being 12.9 and the highest value was 90.0. Whereas after OPCAB, the median value is 32.5 with a minimum of 15.0 and a maximum of 86.0. The statistical test results show significance with a value of p = 0.016.

Table 4. Comparison of kidney function of patients undergoing CABG and OPCAB procedures

Characteristics	CABG	OPCAB	p-value ⁺
Preoperative ureum	23.95 (11.0-39.8)	26.0 (12.9-90.0)	0.018*
Postoperative ureum	39.00 (17.0-71.0)	32.5 (15.0-86.0)	0.049*
Preoperative creatinine	0.83 (0.49-1.08)	0.93 (0.57-1.10)	0.0001*
Postoperative creatinine	0.82 (0.40-1.15)	0.88 (0.38-1.11)	0.187
Preoperative Creatinine Clearance	93.06 (38.28-184.53)	85.96 (34.81-162.44)	0.086
Postoperative Creatinine Clearance	86.81 (39.06-175.00)	89.00 (40.49-215.50)	0.926

⁺Statistical analyses were performed using Mann-whitney test

*Statistical significant was found in p-value <0.05

Table 4 showed results of the urea examination before the procedure, there were differences between the two groups with a p-value of 0.018. This was also followed by urea differences after the procedure of either CABG or OPCAB with a p-value of 0.049. Furthermore, for creatinine before the procedure, there was a statistically significant difference with a p-value of 0.0001. Based on the median value, it was seen that the serum creatinine of patients in the OPCAB group was higher than CABG (0.93 versus 0.83). However, there was no statistically significant difference at the time after the procedure, where the result of the p-value obtained was 0.187. When viewed from the median value, the creatinine value in the CABG group is 0.82 compared to the OPCAB group of 0.89. While the last variable assessed was CrCl, where no significant difference was found at the time before the action ($p = 0.086$). Likewise, after the procedure, the value of $p = 0.926$ is obtained. However, when viewed at the median OPCAB value is 89 compared to CABG which is 86.81.

4 DISCUSSION

Coronary artery bypass grafting (CABG) is a procedure that uses autologous arteries or veins as an alternative graft of coronary arteries that have been blocked due to atherosclerotic plaques either partially or completely (Alexander & Smith, 2016).

Based on research from Asimakopoulos in 2005, the age of patients undergoing the CABG procedure was in the range of 55 years to 75 years. Slightly different results were obtained in Reents's 2014 study, where the average age of patients was 78 years, slightly older than the upper limit of the Asimakopoulos study. Whereas in this study, the average age of patients in the CABG on-pump group was 52.1 years with a standard deviation of 5.22 years. Similar results were found in the OPCAB group of 5.23 ± 6.28 years. In our study, there were no significant differences based on age in the two groups (Asimakopoulos, 2005; Reents, 2014).

For sex, the majority of our study was male, and the figure was almost 90% in the CABG group, with 87.8% compared to OPCAB at 85%. Whereas in previous studies, male groups ranged from 70% to 80% (Asimakopoulos, 2005; Reents, 2014).

The use of a cardiopulmonary bypass (CPB) machine or what is often called an on-pump (CABG) is considered to play a role in the risk of acute postoperative kidney injury when compared to an off-pump (OPCAB). This decrease can reach 17%. Even this relative and absolute risk reduction

can be found in patients with chronic kidney disease before surgery (Garg, 2014).

The Aimakopoulos study carried out an analysis of 704 patients divided into two groups, 404 patients who underwent the OPCAB procedure and 300 patients who underwent the CABG procedure. In this study measurement of kidney function in the form of creatinine clearance (CrCl) (mL/min) and plasma creatinine ($\mu\text{mol/L}$). The study compared plasma CrCl and creatinine in the condition before surgery and followed up on the first and fourth days postoperatively. In both groups, there were no differences in initial values before the procedure, both in the group with OPCAB or with CABG. Whereas at follow-up, there was only a difference in plasma creatinine on the first day, and the difference was not significant at the fourth day of follow-up (Asimakopoulos, 2005).

Another study from Wang in 2003 stated that CrCl use in post-cardiac surgery evaluation was better estimated than plasma creatinine (Wang, 2003). The results of these studies form the basis of research from Asimakopoulos in 2005.

In our study, we used serum creatinine values, urea levels, and creatinine clearance. This study divides patients who run the CABG procedure with the on-pump method and also off-pump. We compared each preoperative value of urea, creatinine, and CrCl. However, there were significant differences in the baseline data before the procedure on urea (CABG= 23.95; OPCAB= 26.0) with $p= 0.018$ and creatinine (CABG= 0.83; OPCAB= 0.93) with $p= 0.0001$.

Then a postoperative kidney function examination was performed and compared the results of each. In this study, there were significant results between urea after the OPCAB and CABG procedures with a p-value of 0.049 with urea values in the CABG group having a higher median (39.00) compared with the OPCAB group (32.50). Furthermore, creatinine after the CABG procedure was higher than creatinine after the OPCAB procedure and this difference had a statistically significant value ($p= 0.0001$). However, when seen the median decline that occurred, in the CABG group, the median decrease was only 0.01 while in the OPCAB group, the median decline occurred at 0.05. The last component we assessed was CrCl where there was a statistically significant reduction in the group with the on-pump CABG procedure when compared to the group of patients who underwent the OPCAB procedure ie between 89.00 in the OPCAB group and 86.81 in the CABG group ($p= 0.926$).

The same results were obtained in the Garg study, 2014 which compared the variable serum creatinine between on-pump and off-pump. The

result was that the off-pump group had an average of 114 versus the on-pump group with an average of 120 (Garg, 2014).

When viewed one by one the comparison between the values before and after the CABG procedure, the area is obtained before the median is 23.95 (11.0-39.8) and after 39.00 (17.0-71.0) with a p-value of 0,0001. This indicates an increase in urea in postoperative conditions. Furthermore, for creatinine variables, in the condition before the procedure, the median value of 0.83 and after was 0.82 and there were no significant differences in the two variables ($p= 0.052$). The last variable was creatinine clearance, where before the CABG procedure, the median was 93.06 and after the median CABG, it was 86.81. However, there was no difference that was statistically significant ($p= 0.106$).

Whereas in the OPCAB procedure, the median urea before surgery is 26.0 while after, the median increases to 32.5. There was a statistically significant difference ($p= 0.016$). Furthermore, in creatinine, obtained before the OPCAB procedure, the median value was 0.93 while after the procedure it was 0.88 with a p-value of 0.061. However, when viewed in comparison, the creatinine value appears to have improved after the OPCAB procedure. The latest data assessed were creatinine clearance, where the median value before OPCAB was 85.96 and this median value increased to 89.00 after OPCAB, but the increase was not statistically significant ($p= 0.060$).

Based on Asimakopoulos's research in 2015, for plasma creatinine values obtained a median of 95 in the OPCAB condition before surgery, this result was decreased after the first day's operation to 96, and on the fourth day, the value decreased to 98. Whereas in the CABG procedure, the median value was preoperative of the plasma creatinine is 93, the first and fourth postoperative days are 99. However, there is no difference between these three variables between the pre and post values both those undergoing the CABG or OPCAB procedures (Asimakopoulos, 2015).

For creatinine clearance values, the value also decreased in OPCAB, the median value at preoperative was 72, the postoperative first day was 71, and postoperative fourth day was 68. As for CABG, the preoperative median was 74, the postoperative first day is 71, and the fourth day is 70 (Asimakopoulos, 2015).

Coronary artery bypass grafting procedures with either the on-pump or off-pump method only minimally affect kidney function. The different procedures also do not differ from each other against creatinine clearance and also serum creatinine. However, there are differences in urea levels.

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