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Original Article

Assessment of role of Renal Insufficiency on In-hospital Outcomes after Off-pump Coronary Artery Bypass Surgery

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ABSTRACT

Introduction*: Renal insufficiency or chronic kidney disease (CKD) is a predictor of in-hospital outcome after coronary artery bypass grafting (CABG). It is well established that the presence and progression of cardiovascular disease and CKD are often intimately associated. Historically, the shift towards off-pump coronary artery bypass (OPCABG) grafting was proposed to avoid the deleterious effects of the contact of blood with the artificial extracorporeal circuit (i.e., mainly the systemic inflammatory response and coagulopathy).* ***Objectives****: To assess the in-hospital outcome of Off Pump CABG in patients with impaired renal function.* ***Methods & Materials****: This prospective observational study was conducted in Department of Cardiac Surgery, United Institute of Cardiovascular Science (UICVS), Dhaka. Sampling technique was purposive sampling. Ethical approval was obtained from the institute ethical review board. Patients of significant coronary artery disease underwent CABG were selected. Then study population were allocated into two groups- group-A, (patients with renal insufficency, e-GFR ≤60 ml/min/1.73 m^2) and group-B (patients free from renal dysfunction, eGFR of >60 ml/min/1.73 m^2). Post operatively follow-up was done and in-hospital outcome was evaluated. Data was processed and analysed with the help of computer program SPSS and Microsoft excel.* ***Result****: Mean age was found 54.6±8.3 years. Male and female ratio was 2.8:1. Study shows that 105(82.0%) of the patients recovered without any complication, among them 75.0% patients in group-A and 89.0% patients in group-B. In group-A, 12.5% had developed acute kidney injury, but none of case detected AKI in group-B. Other outcomes between groups were statistically non-significant.* ***Conclusion****: Present study concluded that major morbidities were found similar in both groups. Only post-operative AKI was significant finding in CKD patients, others were non-significant between groups.*

Keywords*: Renal Insufficiency, Off-pump Coronary Artery Bypass Surgery, Chronic Kidney Disease, n-hospital Outcomes*

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INTRODUCTION

Coronary artery disease (CAD) is the global burden of disease[1]. As a result of an epidemiological transition for last few decades, cardiovascular diseases (CVD) are being considered as an important cause of mortality and morbidity in many developing countries including Bangladesh[2]. There are many risk factors, e.g., diabetes mellitus (DM), hypertension (HTN), obesity, smoking and dyslipidaemia associated with CAD[3]. More evidence is emerging on the strong association between renal dysfunction or chronic kidney disease (CKD) and cardiovascular disease. Several pathogenic mechanisms might be suggested to explain this strong interaction between atherosclerosis, CAD and impact of renal dysfunction[4].

The prevalence of chronic kidney disease has grown exponentially due to an increase in the incidence of diabetes mellitus, hypertension, obesity and metabolic syndrome. CKD or renal dysfunction increased the morbidity and mortality in patients with CAD[5, 6]. In-hospital and long-term outcomes of coronary artery bypass grafting (CABG) surgery is also poorer in patients with renal insufficiency.

CABG and percutaneous coronary intervention (PCI) are important treatment options for coronary heart disease[6]. The 2014 European Society of Cardiology and the European Association for Cardio-Thoracic Surgery Guidelines on myocardial revascularization recommends CABG over PCI (Class IIa) in patients with moderate to severe CKD and multivessel disease when the surgical risk profile is acceptable and life expectancy is more than 1 year[7]. Patients with renal insufficiency or CKD tend to have advanced cardiovascular disease and more accelerated coronary artery atherosclerosis than patients with normal kidney function. Furthermore, CKD is an independent risk factor for postoperative renal dysfunction after CABG. Therefore recent study demonstrated

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the benefits of off-pump CABG over the on-pump technique in CKD patients[8].

There are many significant advantages exits in off-pump procedures. Avoidance of CPB also avoids the need to cannulate the right atrium and aorta. Aortic cannulation and/or manipulation are believed to cause emboli, especially in elderly patients with atherosclerotic disease, which may contribute to kidney failure and stroke[9]. CPB requires heparinization, causes hemodilution from the prime volume in the CPB machine, activates both inflammatory and clotting cascades, and usually results in nonpulsatile perfusion, all of which can result in further kidney injury. So, off-pump CABG (OPCAB) is beneficial for patients with CKD. Previous study reported, on-pump strategy for patients with severe chronic kidney disease was associated with a significantly higher risk of mortality and morbidities[10].

In a study reported that in-hospital mortality was not affected by mild renal dysfunction (RD) but was heavily influenced by moderate and severe dysfunction. As eGFR decreased, it was associated with an increasing rate of reexploration for bleeding, deep sternal wound infection, major adverse cardiac events, prolonged ventilation and length of stay greater than 14 days[11]. In a cohort, 37% of patients undergoing CABG had an eGFR suggestive of chronic kidney disease (60 mL/min per 1.73 m^2). These patients stayed a median of 2 days longer in hospital after CABG, accounted for 70% of all deaths within the first 30 days of surgery, and were twice as likely to die during long-term follow-up[5].

CKD, even from mild to moderate, implies an increase in mortality after CABG. Patients with CKD are older, have a higher prevalence of diabetes and hypertension, and these factors are also associated with higher operative mortality. Despite this association, it is believed that chronic kidney disease is an independent risk factor for CABG, even off-pump. But the extent and magnitude of worse outcome scarcely defined. Many studies were conducted previously among patients with non-CKD and off-pump versus on-pump. There was limited previous study in Bangladesh on comparison of in-hospital outcome in patients with CKD (or impaired renal function) versus non-CKD after off pump CABG. So, the study is time worthy and quite justified.

OBJECTIVES

To assess the in-hospital outcome of Off Pump CABG in patients with impaired renal function

METHODS & MATERIALS

Study design: This prospective observational study was conducted at Department of Cardiac Surgery, United Institute of Cardiovascular Science (UICVS), Dhaka. Patients with significant coronary artery disease planned for coronary artery bypass graft (CABG) surgery were selected. Exclusion criteria include: patients off Pump CABG converted to on Pump CABG, patients undergoing combined CABG and valvular or congenital cardiac procedures, severe systemic disease such as hepatic failure, respiratory failure, cerebrovascular accident and emergency CABG. After fulfilling the inclusion and exclusion criteria, patients were enrolled with unique ID. Ethical approval was obtained from the ethical review board. Then study population were allocated into two groups- group-A (patients of CKD, e-GFR ≤60 ml/min/1.73 m^2) and group-B (patients free from renal dysfunction, eGFR of >60 ml/min/1.73 m^2). Renal dysfunction was confirmed by patient's history, previous medical recorded & available investigation report. CKD was classified based on the eGFR and the level of proteinuria and helps to risk stratify patients. Patients are classified as G1-G5, based on the eGFR, (KGIGO 2012 Clinical Practice Guideline for the Evaluation and Management of Chronic Kidney Disease, 2017 & Anon, 2018).

Follow up and Data collection: The patient kept under followed up daily until recovered or discharge from hospital. Hospital morbidity referred as length of stay in the ICU, atrial fibrillation, low cardiac output syndrome and cerebrovascular accident (Barbosa et al, 2011). Hospital operative mortality as defined as the one occurring within 30 days from the date of surgery or during hospitalization, regardless of the time elapsed since the operation (Barbosa et al, 2011 & Ferguson et al., 2000). Acute kidney injury was defined as an increase in serum creatinine levels to ≥50 % from baseline levels or a decrease in urinary output to < 0.5 ml/kg/hr for more than 6 hours. Serum Creatinine, blood urea level and 24 hours urinary output was assessed. The patients was classified according to the RIFLE criteria (Risk, Injury, Failure, Loss and End stage renal disease). In this study 2011 ACCF/AHA Guideline for Coronary Artery Bypass Graft Surgery adverse events used for assessment of in-hospital outcome (Hillis L et al, 2011). All the information recorded in data collection sheet.

Data analysis: Patient data, clinical & laboratory findings was noted and correlated. All information collected in data collection sheet. Questionnaire is checked very carefully to identify the error in the data. After editing and coding, the coded data directly entered into the computer by using SPSS 21 version. The quantitative data was expressed as mean and standard deviation and qualitative data was expressed as frequency and percentage. Discrete or qualitative variables was analyzed by Chi-squared (χ^2) test and continuous variables analyzed by t-test. A "P" value <0.05 considered as significant.

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RESULT

Table – I: Demographic profile of the respondents (*n*=128)

	Group A (*n* = 64)	Group B (*n* = 64)	*p*-value
Age (years)			
31-40	8 (12.5)	5 (7.8)	
41-50	21 (32.8)	26 (40.6)	0.158
51-60	32 (50.0)	29 (45.3)	
61-70	3 (4.6)	4 (6.2)	
Mean ± S.D.	54.4±8.2	54.9±8.5	
Gender			
Male	47 (73.4)	48 (75.0)	0.965
Female	17 (26.5)	16 (25.0)	
Residence			
Rural	16 (25.0)	19 (29.6)	0.408
Urban	48 (75.0)	45 (70.3)	
BMI	25.7±3.2	25.6±2.9	0.853

Table I showed demographic profile. Mean age was found 54.4±8.2 years in Group-A and 54.9±8.5 years in Group-B. Out of 128 cases 95(74.2%) cases were male and 33(25.7%) were female. Male and female ratio was 2.8:1. Large numbers of respondents came from urban area 93(72.6%). There was no significant difference in between groups in respect of demographic profile.

Table – II: Preoperative laboratory profile & cardiac status of the respondents (*n*=128)

Variables	Group A (*n* = 64)	Group B (*n* = 64)	*p*-value
CAG Findings			
Double-vessel disease (DVD)	6 (9.3)	11 (17.1)	
Triple vessel disease (TVD)	58 (90.6)	53 (82.2)	0.236
ECHO finding			
LVEF (%)	48.5±2.9	49.1±3.6	0.132
Laboratory profile			
Hb% (gm/dl)	1.29±0.59	13.4±0.71	0.109
S. creatinine (mg/dl)	37.1±0.04	0.96±0.05	0.089
Blood urea (mg/dl)	12.9±4.30	32.3±4.52	0.109

Preoperative angiography and extent of vascular lesion revealed that, number of indicated lesions of coronary artery disease was similar between both groups. The chi-square statistic is 8.5348. The p-value is .07384. The result is not significant at p<0.05. Mean LVEF was found 48.5±2.9 in Group A patients and 49.1±3.6 in Group B patients. Baseline serum creatinine showed that, 1.29±0.04 mg/dl and 0.96±0.05 mg/dl in group A & B respectively. Blood urea showed that, 32.3±4.52 mg/dl in group-B and 37.1±4.07 mg/dl in group-A patients. There was no significant difference in between two groups. (Table II).

Table – III: Comparison of postoperative outcome variables between groups (*n*=128)

Variables	Group A (*n* = 64)	Group B (*n* = 64)	*p*-value
Stroke	0	0	-
Arrhythmia	9 (14.0)	6 (9.3)	0.091
AKI	8 (12.5)	0	0.001
Myocardial dysfunction			
Troponin I (>8.49 ng/ml)	2 (3.1)	2 (3.1)	1.000
CKMB (>5 × ULN, or >40 ng/ml	2 (3.1)	1 (1.5)	0.594
Re-exploration for bleeding	2 (3.1)	1 (1.5)	0.594
Wound infection	3 (4.6)	1 (1.5)	0.812

Postoperative outcome showed that 105(82.0%) of the patients recovered without any complication, among them 75.0% patients in group-A and 89.0% patients in group-B. In group-A, 12.5% had developed acute kidney injury, but in group B no AKI was occurred. Arrhythmia was developed 14.0% patients in group-A and 9.3% patients in group-B. Re-exploration for bleeding required in 3.1% patients in group-A and 1.5% patients in group-B. Other outcomes between groups were statistically non-significant. (Table III).

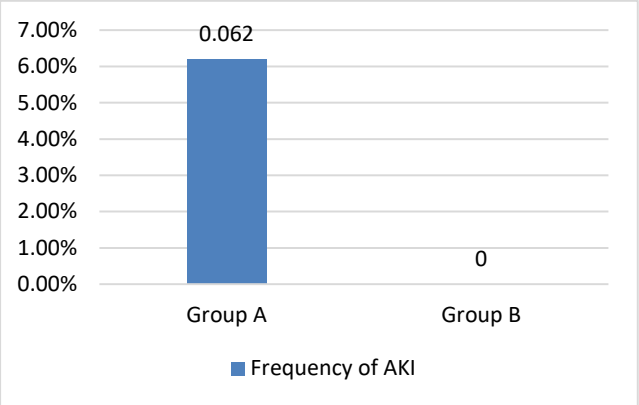

Figure – 1: Prevalence of acute kidney injury (AKI) in both study group (*n*=128)

Figure 1 showed frequency of acute kidney injury (AKI) in study subjects. AKI was 8(12.5%) in group A patients, but none of case detected AKI in group-B. The difference was - significant statistically (p=0.001).

DISCUSSION

This study was conducted to evaluate the in-hospital outcome of Off Pump CABG in patients with impaired renal function. It was observed that majority, e.g., 61(47.6%) patients belonged to age 51-60 years, mean age was found 54.4±8.2 years in Group-A and 54.9±8.5 years in Group-B. Male and female ratio was 2.8:1. There was no significant difference in respect to demographic profile in between two groups.

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Findings consistent with result of other study. In a study total of 28770 patients were enrolled. Mean age was 62.8 ± 11.3 years and 37% were male[12]. Hillis & his colleague (2006) reported that average age was 66 (59–72) years[5]. In another study shows mean age was 63.2 ± 10.0 years[4]. So all findings accordance with result of this study.

In this study our aim was to see the impact of renal impairment in post-operative outcome after off Pump CABG. Study showed that 105(82.0%) of the patients recovered without any complication, among them 75.0% patients in group-A and 89.0% patients in group-B. In group-A, 12.5% had developed acute kidney injury. Arrhythmia was developed 14.0% patients in group-A and 9.3% patients in group-B. Re-exploration for bleeding required in 3.1% patients in group-A and 1,5% patients in group-B. Other outcomes between groups were statistically non-significant.

In a study out of 3,890 patients, 362 (9.3%) had CKD. In-hospital outcomes revealed greater incidence of stroke (5.5% vs 2.1%), atrial fibrillation (16 vs 8.3%) and greater mortality (10.5% vs 3.8%) in CKD vs non-CKD respectively[13].

Previous meta-analyses of randomized trials have shown a similar incidence of atrial fibrillation, blood transfusions, infections, and length of stay in the hospital and intensive care unit[14, 15]. Thus, although there was evidence of benefit with off-pump CABG in patients with renal insufficiency, the most important outcomes that many were hoping would improve, namely stroke, kidney failure, myocardial infarction, and mortality.

Present study showed that postoperative complications of CKD patients were almost similar with non-CKD (except AKI). In group-A, 12.5% had developed acute kidney injury, but in group B no AKI was occurred. So, assumption of higher morbidity & mortality is not true. Recently published studies reported the overall incidence of postoperative AKI after OPCAB as 17.5%, and as 19.2% in CKD patients, specifically. Most of these presented on or before POD 2. Patients in the CKD group were higher risk of developing AKI than those in the normal group[8]. Krittayaphong et al (2017) and Barbosa et al (2011) also noted similar observation[12, 13]. So, from above finding it may be concluded that in-hospital outcome is almost similar in both groups, so off-pump coronary artery by-pass grafting may be done safely in patients with renal dysfunction.

CONCLUSIONS

The results of this study concluded that in-hospital outcome was not different between the patients with or without renal dysfunction and postoperative complications was almost similar in both groups, except acute kidney injury (AKI). Prevalence of AKI was 12.5% in group A patients or patients with CKD, but none of case detected AKI in group-B or patients without CKD. The difference was -significant statistically (p=0.001).

REFERENCES

1. *Roth GA, Johnson C, Abajobir A, Abd-Allah F, Abera SF, Abyu G, et al,. Global, Regional, and National Burden of Cardiovascular Diseases for 10 Causes, 1990 to 2015. J Am Coll Cardiol. 2017 Jul 4;70(1):1-25.*
2. *Al Mamun M, Rumana N, Pervin K, Azad MC, Shahana N, Choudhury SR, Zaman MM, Turin TC. Emerging Burden of Cardiovascular Diseases in Bangladesh. J Atheroscler Thromb. 2016;23(4):365-75.*
3. *Roeters van Lennep JE, Westerveld HT, Erkelens DW, van der Wall EE. Risk factors for coronary heart disease: implications of gender. Cardiovasc Res. 2002 Feb 15;53(3):538-49.*
4. *Milane A, Khazen G, Zeineddine N, Amro M, Masri L, Ghassibe-Sabbagh M, et al. Association of coronary artery disease and chronic kidney disease in Lebanese population. Int J Clin Exp Med. 2015 Sep 15;8(9):15866-77.*
5. *Hillis GS, Croal BL, Buchan KG, El-Shafei H, Gibson G, Jeffrey RR, Millar CG, Prescott GJ, Cuthbertson BH. Renal function and outcome from coronary artery bypass grafting: impact on mortality after a 2.3-year follow-up. Circulation. 2006 Feb 28;113(8):1056-62.*
6. *Bangalore S, Guo Y, Samadashvili Z, Blecker S, Xu J, Hannan EL. Revascularization in Patients With Multivessel Coronary Artery Disease and Chronic Kidney Disease: Everolimus-Eluting Stents Versus Coronary Artery Bypass Graft Surgery. J Am Coll Cardiol. 2015 Sep 15;66(11):1209-1220.*
7. *Windecker S, Kolh P, Alfonso F, Collet JP, Cremer J, Falk V, Filippatos G, et al,. 2014 ESC/EACTS Guidelines on myocardial revascularization: The Task Force on Myocardial Revascularization of the European Society of Cardiology (ESC) and the European Association for Cardio-Thoracic Surgery (EACTS)Developed with the special contribution of the European Association of Percutaneous Cardiovascular Interventions (EAPCI). Eur Heart J. 2014 Oct 1;35(37):2541-619.*
8. *Kim JW, Sim HT, Yoo JS, Kim DJ, Cho KR. Results of Protocol-based Perioperative Management in Off-Pump Coronary Artery Bypass Grafting for Patients with Non-dialysis-dependent Chronic Kidney Disease. Korean J Thorac Cardiovasc Surg. 2016 Dec;49(6):427-434.*
9. *Bainbridge, D and Martin, J. (2009). Off-Pump Coronary Artery Bypass Surgery and the Kidney, American Journal of Kidney Diseases, 54(3), pp., 395-398.*
10. *Kim HJ, Kim JB, Jung SH, Choo SJ, Lee JW, Chung CH. Coronary artery bypass grafting in patients with severe chronic kidney disease: a propensity score-weighted analysis on the impact of on-pump versus off-pump strategies. Eur J Cardiothorac Surg. 2017 Nov 1;52(5):937-944.*
11. *Boulton BJ, Kilgo P, Guyton RA, Puskas JD, Lattouf OM, Chen EP, Cooper WA, Vega JD, Halkos ME, Thourani VH. Impact of preoperative renal dysfunction in patients undergoing off-pump versus on-pump coronary artery bypass. Ann Thorac Surg. 2011 Aug;92(2):595-601.*
12. *Krittayaphong R, Rangsin R, Thinkhamrop B, Hurst C, Rattanamongkolgul S, Sripaiboonkij N, Wangworatrakul W. Prevalence of chronic kidney disease associated with cardiac and vascular complications in hypertensive patients: a multicenter, nation-wide study in Thailand. BMC Nephrol. 2017 Apr 3;18(1):115.*
13. *Barbosa, R., Cestari, P., Capeletti, J., Magnus, G., Ibañez, T and Silva, P. (2011). Impact of Renal Failure on In-hospital Outcomes after Coronary Artery Bypass Surgery, Arq Bras Cardiol, 97(3), pp., 249-253.*
14. *Reston JT, Tregear SJ, Turkelson CM. Meta-analysis of short-term and mid-term outcomes following off-pump coronary artery bypass grafting. Ann Thorac Surg. 2003 Nov;76(5):1510-5.*
15. *Cheng DC, Bainbridge D, Martin JE, Novick RJ; Evidence-Based Perioperative Clinical Outcomes Research Group. Does off-pump coronary artery bypass reduce mortality, morbidity, and resource utilization when compared with conventional coronary artery bypass? A meta-analysis of randomized trials. Anesthesiology. 2005 Jan;102(1):188-203.*