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Preoperative CRP On Postoperative AKI In Patients Undergoing OPCAB

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ABSTRACT

Introduction: Cardiovascular diseases are the number one cause of death globally, an estimated 17.9 million people died from cardiovascular diseases in 2016, representing 31% of all global deaths. Off pump coronary artery bypass grafting (OPCAB) is established and definite treatment option for coronary artery disease. **Objective:** To evaluate the impact of preoperative CRP on postoperative renal function in patients undergoing OPCAB. **Methodology:** A Prospective Cohort Study was Conducted at Department Of Cardiac Surgery, National Heart Foundation Hospital And Research Institute, Mirpur, Dhaka, Bangladesh from January, 2017 To October, 2018. Patients undergoing isolated OPCAB in the department of cardiac surgery in NHFH & RI after fulfillment of inclusion and exclusion criteria were taken as study population. The patients were prospectively allocated into two groups, 204 patients in each group: Group A: Patients with preoperative low normal CRP ≤3 mg/L).Group B: Patients with preoperative high normal CRP >3 mg/L (3-6 mg/L). **Results**: Among the 408 patients most were in 46-55 years group (84 in group A and 87 in group B). Age of the patients in years were 54.43 ± 7.27 (Mean ± SD) and 54.49 ± 8.16 (Mean ± SD) in group A and group B respectively and there was no significant (p = 0.939) difference between the two groups. In group A number of patients 187 (91.7%) were male and 17 (8.3%) were female and in group B number of patients 163 (79.9%) were male and 41 (20.1%) were female. There were significant (p = 0.001) difference regarding sex of the patients between the groups. The number of diabetic patients were 97 (47.5%) in group A and 89 (43.6%) in group B. The statistical analysis showed differences in number of diabetic patients were not significant (p = 0.426). In our study we had seen numbers of hypertensive patients were 138 (67.6%) in group A and 127 (62.3%) in group B which was statistically not significant (p = 0.254). Postoperative (within 48 hours) urine volume of the patients in both the groups was statistically not significant (p = 0.608). 103 (50.5%) patients in group A and 124 (50.8%) patients in group B received 1-3 units blood and/or blood products or both. There was no statistically significant (p = 0.096) difference between two group regarding transfusion. Percent of decrease of eGFR in group A was 4.94 ± 9.17 (Mean ±SD) and in group B was 6.51 ± 10.47 (Mean ±SD) which was not statistically significant (p = 0.186). In our study AKI in group A was 11 (5.4 %) and in group B was 33 (16.2%) when measured by serum creatinine and it was significant statistically (odds ratio [OR] 3.39; 95% confidence interval [CI] 1.66-6.91, p<0.001). Postoperative ICU stay was ≤3 days in 191(93.63%) patients of group A and 186 (91.18%) patients of group B. Only 13 (6.37) patients of group A and 18 (8.82) patients of group B, had to stay >3 days in ICU, which was not statistically significant (p=0.999). Postoperative hospital stay was ≤14 days in 203 (99.5%) patients of group A and 203 (99.5%) patients of group B. Only 1 (0.5%) patients of group A and 1(0.5%) patients of group B, had to stay >14 days in hospital after operation, which was not statistically significant (p = 0.999).**Conclusion:** Postoperative AKI depends on many risk factors like poor LVEF, CPB, OPCAB itself, diabetes mellitus, hypertension and of course preoperative high baseline CRP. This prospective cohort study showed that preoperative high normal (3 to 6 mg/L) level of CRP increases the risk of AKI after OPCAB. This study suggests that preoperative CRP may be used as a predictor of AKI after OPCAB.

Keywords: *Preoperative CRP, Postoperative Renal Function, OPCAB*

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INTRODUCTION

Cardiovascular diseases are the number one cause of death globally, an estimated 17.9 million people died from cardiovascular diseases in 2016, representing 31% of all global deaths. Of these deaths, 85% are due to heart attack and stroke. These diseases have remained the leading causes of death globally in the last 15 years [1]. Off pump coronary artery bypass grafting (OPCAB) is established and definite treatment option for coronary artery disease. In National Heart Foundation Hospital & Research Institute (NHFH & RI) out of 2206 cardiac surgery, about 1232 coronary artery bypass graft (CABG) done in 2016 [2]. Acute kidney injury (AKI) is one of the most frequently occurring complications after OPCAB surgery [3]. Cellular ischaemia is an important factor in AKI following cardiac surgery, which leads to vascular endothelial and tubular epithelial injury [4]. Recent research [5] shows that the incidence of post cardiac surgery AKI varies from 5 to 42 % depending on the definition of AKI. The RIFLE score has been proposed as consensus criteria of the Acute Dialysis Quality Initiative Workgroup [6] and has been validated in cardiac surgery [7]. According to the RIFLE criteria AKI is defined as increase of serum creatinine ≥150-200% (1.5-2 fold) or decrease of GFR >25% or urine output <0.5 ml/kg/hr for 6 hours. Various perioperative risk factors for postoperative AKI have been identified. Among the important preoperative factors are advanced age, reduced left ventricular function, emergency surgery, preoperative use of intra-aortic balloon pump, elevated preoperative serum glucose and creatinine. Most important intraoperative risk factor is the intraoperative haemodynamic instability and all the causes of postoperative low output syndrome comprise the postoperative risk factors [8]. Olsson, et al [9] found that during a mean follow-up of 4.1 years, there was 5.5% incident heart failure (HF) among the patients who developed AKI after CABG. Additionally, the development of postoperative AKI increases mortality risks significantly, lengthens hospital stays and worsens long-term morbidity [10].There is a burden of evidence showing that C-reactive protein (CRP) is an independent predictor of long-term cardiovascular events in healthy subjects [11]. Furthermore, increased serum levels of CRP have been shown to predict poor outcome in patients with unstable angina [12] and myocardial infarction [13] as well as with ischemic stroke [14] & early and late cardiac events after coronary angioplasty [15], but scant data exists on its impact on the outcome after CABG (Gaudino, et al[16] that's why it should be explored thoroughly. CABG was one of the unexplored fields in terms of the predictive role of CRP for AKI except few article like - Shacham, et al [17] suggested that the high CRP group had an increased rate of AKI compared with the low CRP group (17% versus 6%). The increased CRP modulated the phenotype of macrophages and Fc-gamma receptors, which may explain the mechanism of CRP-induced kidney damage [4]. Another study found that the regeneration of kidney tubular cells after ischemia reperfusion injury was inhibited [18]. The impaired transition between G1 and S phases mediated this result of tubular regeneration. Other pathologic roles of CRP, such as its involvement in the activated clotting cascade [19], enhanced adhesion molecules [20], and impaired antioxidant defenses [21], may be directly or indirectly related to the development of AKI. The aim of this study was to address whether there was any impact of preoperative CRP on postoperative AKI in patients undergoing OPCAB.

METHODOLOGY

Type Of Study: Prospective Cohort Study.
Place Of Study: Department Of Cardiac Surgery, National Heart Foundation Hospital And Research Institute, Mirpur, Dhaka, Bangladesh.
Period Of Study: January, 2017 To October, 2018.
Study Population: Patients undergoing isolated OPCAB in the department of cardiac surgery in NHFH & RI after fulfillment of inclusion and exclusion criteria were taken as study population.

Inclusion criteria:

- Patients undergoing isolated OPCAB in the department of cardiac surgery in NHFH & RI.

Exclusion criteria:

- Patients underwent emergency surgery.
- Patients underwent redo-surgery.
- Patients with preoperative serum creatinine > 1.4 mg/dl, or eGFR < 30 ml/min/1.73 m^2 or patients requiring dialysis.
- Patients with a left ventricular ejection fraction of less than 30%.
- Those with acute or chronic pulmonary disease.
- Patients with associated liver dysfunction.
- Patients with associated valvular heart disease.
- Patients with associated congenital heart disease.
- Patients required conversion to on-pump procedures.
- Patients required re-operation for any cause.
- Patients having anaemia (Haemoglobin <13 gm/dl for men and < 12 gm/dl for female).

Sample Size: Total 204 patients were included. According to prior published article [22] prevalence of AKI among the low CRP level (≤3 mg/L) subjects was 12.83% (0.1283) and for high CRP group (>3 mg/L) was 23.5% (0.235). We were planning a study of independent exposed and unexposed group with 1 unexposed per exposed patient. If the true AKI rate among exposed group is 0.235, we needed to study 204 exposed subjects and 204 unexposed subjects to be able to reject the null hypothesis that the AKI rates for exposed subjects and unexposed subjects were equal with probability (power) 0.8. The Type I error probability associated with this test of this null hypothesis was 0.05. We used an uncorrected chi-squared statistic to evaluate this null hypothesis.

Grouping of Patient: The patients were prospectively allocated into two groups, 204 patients in each group:
Group A: Patients with preoperative low normal CRP ≤3 mg/L).
Group B: Patients with preoperative high normal CRP >3 mg/L (3-6 mg/L).

Operational Definitions:
CRP Level: For this study pre-procedural baseline CRP levels were defined and stratified into 2 groups according to the American Heart Association (AHA) criteria:
Group A: Patients with preoperative low normal CRP ≤3 mg/L
Group B: Patients with preoperative high normal CRP >3 mg/L (3-6 mg/L)
Preoperative serum creatinine: Preoperative serum creatinine was taken during preoperative routine checkup after admission in the hospital for OPCAB.
Preoperative eGFR: Preoperative calculation of eGFR was done during preoperative routine checkup after admission in the hospital for OPCAB.
Postoperative serum creatinine: Highest value within 48 hours of postoperative period was taken as postoperative serum creatinine level.
Postoperative eGFR: Calculation of postoperative eGFR, was done from postoperative serum creatinine level.

Methodology: After admission of patient for CABG, informed consent was taken from each subject before enrolment. All demographic and clinical data were prospectively collected in a dedicated data base. CRP was measured by SIEMENS Dimension EXL 200 Integrated Chemistry System using particle-enhanced turbidimetric immunoassay technique (Flex Reagent Cartridges, Dade Behring Inc.) Standard anesthetic techniques were used for all patients. A uniform OPCAB operative technique was used for all patients. All patients were operated through a median sternotomy approach. Target coronary arteries were stabilized using stabilizing system, appropriate intra coronary shunts were used in all cases to maintain distal perfusion and to achieve bloodless field. Following the surgical procedure, all the patient was brought to the cardiovascular intensive care unit where they were monitored until the patients were extubated and stabilized the hemodynamic status. Then the patients were transfer to the post ICU and then postoperative ward whenever appropriate according to the ICU consultant's judgment. Blood samples were taken for measurement of variables on every day from day 1 to day 3 of postoperative stay in hospital. The patients were discharged from postoperative ward and were advised for subsequently follow up.

Data Collection: Data were collected by interview of the patients, clinical examination, laboratory investigations, preoperative, peroperative and postoperative findings using the research instrument.

Statistical Analysis: Data was analyzed by the software statistical program for social sciences (SPSS 25.0 Inc). Categorical variables were present as frequency & percentage and continuous variables were shown as mean ± SD. Statistical analyses were performed by *Chi-square* test and/or Fisher's exact test where it as applicable for comparing qualitative variables and for quantitative variables using unpaired *t*-test & Mann-Whitney U test for comparing between the groups. Pearson's Correlation Coefficient test was done to observe the correlation of postoperative outcome with preoperative CRP. Multivariate logistic regression analysis was performed to identify significant predictors of composite outcome using variables. Odds ratio (OR) and associated 95% confidence interval (CI) was estimated. A p-value of <0.05 was considered as significant for all analytical tests. The summarized data was presented in the form of tables.

RESULTS

Among the 408 patients most were in 46-55 years group (84 in group A and 87 in group B). Age of the patients in years were 54.43 ± 7.27 (Mean ± SD) and 54.49 ± 8.16 (Mean ± SD) in group A and group B respectively and there was no significant (p = 0.939) difference between the two groups. In group A number of patients 187 (91.7%) were male and 17 (8.3%) were female and in group B number of patients 163 (79.9%) were male and 41 (20.1%) were female. There were significant (p = 0.001) difference regarding sex of the patients between the groups. Among the 408 patients most were in normal BMI group (106 patients in group A and 98 patients in group B). BMI of the patients in kg/m^2 were 25.26 ± 2.94 (Mean ± SD) and 25.62 ± 3.53 (Mean ± SD) in group A and group B respectively and there was no significant (p = 0.268) difference between the two groups. In group A weight of patients in kg were 66.29 ± 8.44 (Mean ± SD) and 65.59 ± 10.15 (Mean ± SD) in group B and there were no significant (p = 0.452) difference between the groups. In group A body surface area of patients in square meter were 1.72 ± 0.13 (Mean ± SD) and 1.70 ± 0.16 (Mean ± SD) in group B

and there were no significant (p = 0.137) difference between the both group. In group A serum bilirubin of patients in mg/dl were 0.52 ± 0.17 (Mean ± SD) and 0.53 ± 0.15 (Mean ± SD) in group B and there were no significant (p = 0.604) difference between the both group. In group A, 188 (92.2%) patients were in NYHA functional class II and 16 (7.8%) were in class III. In group B, 181 (88.7%) patients were in NYHA functional class II and 23 (11.3 %) were in class III. However none of the patients were in group I or group IV. The number of diabetic patients were 97 (47.5%) in group A and 89 (43.6%) in group B. The statistical analysis showed differences in number of diabetic patients were not significant (p = 0.426). In our study we had seen numbers of hypertensive patients were 138 (67.6%) in group A and 127 (62.3%) in group B which was statistically not significant (p = 0.254).Most patients in this table were from the 31-50% LVEF group. 111 (54.4%) in group A and 133 (65.2 %) in group B. The difference was significant (p = 0.026) in our study population. In group A total operation time of patients in minutes were 283.48 ± 63.61 (Mean ± SD) and 294.08 ± 61.54 (Mean ± SD) in group B and the difference was not significant (p = 0.088). Postoperative (within 48 hours) urine volume of the patients in both the groups was statistically not significant (p = 0.608). In group A it was 71.28 ± 8.26 ml/hour (Mean ± SD) and in group B it was 70.73 ± 11.01 ml/hour (Mean ± SD). Every patient received 1-7 units blood and/or blood products or both and most number of patients received 1-3 units blood and/or blood products or both (total 227 patients). 103 (50.5%) patients in group A and 124 (50.8%) patients in group B received 1-3 units blood and/or blood products or both. There was no statistically significant (p = 0.096) difference between two group regarding transfusion.

Table-I: Demographic characteristics of the patients (n=408)

Variables	**Group A**	**Group B**	**p value**
Age (year)	54.43 ± 7.27	54.49 ± 8.16	0.939
Sex(Male/Female)	187/17	163/41	0.001
BMI (kg/m^2)	25.26 ± 2.94	25.62 ± 3.53	0.268
Weight (kg)	66.29 ± 8.44	65.59 ± 10.15	0.452
Body surface area (sq. m)	1.72 ± 0.13	1.70 ± 0.16	0.137
Serum bilirubin (mg/dl)	0.52 ± 0.17	0.53 ± 0.15	0.604
NYHA			
Class II	188 (92.2)	181 (88.7)	
Class III	16 (7.8)	23 (11.3)	0.239
Diabetes mellitus	97 (47.5)	89 (43.6)	0.426
HTN	138 (67.6)	127 (62.3)	0.254
LVEF			
Good (LVEF >50%)	93 (45.6)	71 (34.8)	0.026
Moderate (LVEF 31-50%)	111 (54.4)	133 (65.2)	
Total operative time (min)	283.48 ± 63.61	294.08 ± 61.54	0.088
Blood Transfusion			
None	10 (4.9)	10 (4.9)	
1-3	103 (50.5)	124 (50.8)	0.096
4-7	91 (44.6)	70 (34.3)	
Urine volume (ml)	71.28 ± 10.62	70.73 ± 11.01	0.608

Group A: Patients with preoperative low normal CRP ≤3 mg/L
Group B: Patients with preoperative high normal CRP >3 mg/L
t test was done to measure the level of significance, (significant, p< 0.05)
Data was expressed as Mean ± SD

Table-II: Distribution of the patients by change of serum creatinine (mg/dl) between the groups.

Serum Creatinine	**Group A**	**Group B**	**p value**
Pre-op Creatinine	1.11 ± 0.15	1.12 ± 0.16	0.499[a]
Post-op Creatinine	1.25 ± 0.25	1.34 ± 0.36	0.002[a]
Percent of Increased creatinine	13.07 ± 19.80	20.38 ± 28.31	
Mean Rank	190.55	218.45	0.016[b]

[a]*t* test was done to measure the level of significance.
[b]Mann- Whitney U test was done to measure the level of significance.
Preoperative serum creatinine in group A was 1.11 ± 0.15 mg/dl (Mean ±SD) and in group B was 1.12 ± 0.16 (Mean ±SD) which was not statistically significant (p = 0.499). Postoperative serum creatinine in group A was 1.25 ± 0.25 mg/dl (Mean ±SD) and in group B was 1.34 ± 0.36 mg/dl (Mean ±SD) which was statistically significant (p = 0.002). Rise of serum creatinine in group A was 0.14 ± 0.21 mg/dl (Mean ±SD) and in group B was 0.22 ± 0.32 mg/dl (Mean ±SD) which was statistically significant (p = 0.016).

Table-III: Distribution of the patients by change of eGFR (ml/min/1.73 m^2) between the groups.

eGFR	Group A	Group B	p value
Pre-op eGFR	71.22 ± 13.83	68.91 ± 17.29	0.139[a]
Post-op eGFR	64.66 ± 15.86	60.07 ± 19.36	0.009[a]
Percent of decrease eGFR	4.94 ± 9.17	6.51 ± 10.47	
Mean Rank	196.80	212.19	0.186[b]

Preoperative eGFR in group A was 71.22 ± 13.83 ml/min/1.73 m^2 (Mean ±SD) and in group B was 68.91 ± 17.29 ml/min/1.73 m^2 (Mean ±SD) which was not statistically significant (p<0.139). Postoperative eGFR in group A was 64.66 ± 15.86 ml/min/1.73 m^2 (Mean ±SD) and in group B was 60.07 ± 19.36 ml/min/1.73 m^2 (Mean ±SD) which was statistically significant (p<0.009). Percent of decrease of eGFR in group A was 4.94 ± 9.17 (Mean ±SD) and in group B was 6.51 ± 10.47 (Mean ±SD) which was not statistically significant (p = 0.186).

Table-IV: Distribution of the patients by AKI.

	Group A	Group B	p value	Odds Ratio (95% CI)
AKI by creatinine	11 (5.4)	33 (16.2)	<0.001	3.39(1.66-6.91)
AKI by eGFR	4 (2.0)	12 (5.9)	0.041	3.13(0.99-9.86)
AKI by Combined S.Creatinine and eGFR	11 (5.4)	37 (18.1)	<0.001	3.89(1.92-7.86)

In our study AKI in group A was 11 (5.4 %) and in group B was 33 (16.2%) when measured by serum creatinine and it was significant statistically (odds ratio [OR] 3.39; 95% confidence interval [CI] 1.66-6.91, p<0.001). In group A number of AKI patient was 4 (2%) and in group B it was 12 (5.9%) when measured by eGFR and it was significant statistically (odds ratio [OR] 3.13; 95% confidence interval [CI] 0.99-9.86, p = 0.041). In group A number of AKI patient was 11 (5.4%) and in group B it was 37 (18.1%) when measured by both creatinine and eGFR which was significant statistically (odds ratio [OR] 3.89; 95% confidence interval [CI] v (1.92-7.86), p<0.001).

Table-V: Distribution of the patients by duration of ICU stay and postoperative length of hospital stay.

	Group A	Group B	p value
ICU stay (days)			
Normal ≤3	191 (93.63)	186 (91.18)	0.999[a]
Prolonged >3	13 (6.37)	18 (8.82)	
Hospital stay (days)			
Normal ≤14	203 (99.5)	203 (99.5)	0.999[b]
Prolonged >14	1 (0.5)	1 (0.5)	

[a]*Chi-square* test was done to measure the level of significance (significant, p< 0.05).
[b] Fisher exact test was done to measure the level of significance (significant, p< 0.05).
Postoperative ICU stay was ≤3 days in 191(93.63%) patients of group A and 186 (91.18%) patients of group B. Only 13 (6.37) patients of group A and 18 (8.82) patients of group B, had to stay >3 days in ICU, which was not statistically significant (p=0.999). Postoperative hospital stay was ≤14 days in 203 (99.5%) patients of group A and 203 (99.5%) patients of group B. Only 1 (0.5%) patients of group A and 1(0.5%) patients of group B, had to stay >14 days in hospital after operation, which was not statistically significant (p = 0.999).

DISCUSSION

This study population was divided into two groups, 204 in each group. Group A (control) had patients with preoperative low normal CRP (≤3 mg/L) and Group B (case) had patients with preoperative high normal CRP >3 mg/L (3-6 mg/L). In this study among the 408 patients most were in 46-55 years group (84 in group A and 87 in group B). Age of the patients in years were 54.43 ± 7.27 (Mean ± SD) and 54.49 ± 8.16 (Mean ± SD) in group A and group B respectively and there was no significant (p = 0.939) difference between the two groups. In previous study by Gao, et al [22] patient's age was significant (p<0.0001) between the groups which contradicts with our study. In group A number of patients 187 (91.7%) were male and 17 (8.3%) were female and in group B number of patients 163 (79.9%) were male and 41 (20.1%) were female. There were significant (p = 0.001) difference regarding sex of the patients between the groups. Recent study [22] found similar result with male predominance (p<0.0001). Among the 408 patients most were in normal (18.5 – 24.9) BMI group (106 in group A and 98 in group B). BMI of the patients in kg/m^2 were 25.26 ± 2.94 (Mean ± SD) and 25.62 ± 3.53 (Mean ± SD) in group A and group B respectively and there was no significant (p = 0.268) difference between the two groups. Han, et al [23] found significant (p=0.001) difference between groups regarding BMI. In group A weight of patients in kg were 66.29 ± 8.44 (Mean ± SD) and 65.59 ± 10.15 (Mean ± SD) in

group B and there were no significant (p = 0.452) difference between the both group. In previous study Nashef, et al [24] weight of the patients was 77.9 ± 15.9 kg (Mean ± SD). In group A body surface area of patients in square meter were 1.72 ± 0.13 (Mean ± SD) and 1.70 ± 0.16 (Mean ± SD) in group B and there were no significant (p = 0.137) difference between the both group. Nashef, et al [24] found body surface area of patients in square meter was 1.87 ± 0.21 (Mean ± SD). Hence, among the demographic variables, i. e, age, weight, BMI and body surface area differences were not significant but for sex differences it was significant (p = 0.001). OPCAB is a major surgical procedure with a significant stress response. Underlying medical conditions, such as chronic kidney disease, diabetes mellitus, hypertension, cardiovascular disease, liver disease, and chronic obstructive pulmonary disease, are well documented risk factors predisposing a patient to postoperative AKI [10]. Chertow, et al [25] showed in a prospective evaluation of 43,642 patients undergoing cardiac surgery, the risk of postoperative AKI was increased significantly among patients with, chronic obstructive pulmonary disease (OR = 1.55; 95% CI = 1.28–1.88), diabetes mellitus (OR = 1.43; 95% CI = 1.08–1.89), and New York Heart Association class IV status (OR = 2.12; 95% CI = 1.78–2.54). In group A serum bilirubin of patients in mg/dl were 0.52 ± 0.17 (Mean ± SD) and 0.53 ± 0.15 (Mean ± SD) in group B and there were no significant (p = 0.604) difference between the both group. In group A, 188 (92.2%) patients were in NYHA functional class II and 16 (7.8%) were in class III. However none of the patients were in group I or group IV. In group B, 181 (88.7%) patients were in NYHA functional class II and 23 (11.3 %) were in class III. However none of the patients were in group I or group IV. Nashef, et al [24] showed NYHA functional class IV was significantly associated with high mortality. In our study there was no patient in NYHA functional class IV. The number of diabetic patients were 97 (47.5%) in group A and 89 (43.6%) in group B. The statistical analysis showed differences in number of diabetic patients were not significant (p = 0.426). In our study we had seen numbers of hypertensive patients were 138 (67.6%) in group A and 127 (62.3%) in group B which was statistically not significant (p = 0.254). Han, et al [23] found similar findings diabetes mellitus 45.8% in third tertile and 45.4% in second tertile which had no statistically significant (p = 0.959) difference between the groups. They also found 50.8% hypertensive patient in second tertile and 52.1% in third tertile without any statistically significant (p = 0.852) difference. Winter, et al [15] found no significant difference between CRP ≤3 gm/L group and > 3 gm/L group regarding hypertension and diabetes mellitus. Most patients in this table were from the 31-50% LVEF group. 111 (54.4%) in group A and 133 (65.2.5%) in group B. The difference was significant (p = 0.026) in our study population. Recent research Joo, et al.,[26] showed total operative time for OPCAB was 245.1 ± 57.5 minutes and Kumada, et al [27] showed 290 ± 55 minutes which were similar to our study. Every patient received 1-7 grafts and most number of patients received 4 grafts (total 176 patients). 83 patients in group A and 93 patients in group B received 4 grafts. Among the study population, 158 patients received 3 grafts, 82 patients in group A and 76 patients in group B. There was no statistically significant (p = 0.556) difference between two group regarding number of grafts. Han, et al [23] showed number of grafted artery were 2.1 ± 0.56 (mean ± SD) and there were no significant (p = 2.863) difference between CRP groups. One of the most important advantages of the OPCAB technique is that it makes it possible to reduce the rate of blood product transfusions [28]. There was no statistically significant (p = 0.096) difference between two group regarding transfusion. In non-anaemic patients: AKI occurred 1.4% in 0 units; 2.8% in 1 unit; 2.2% in 2 units; 2.8% in 3 units transfusion and preoperative anaemia independently related to AKI [29]. Postoperative (within 48 hours) urine volume of the patients in both the groups was statistically not significant (p = 0.608). In group A it was 71.28 ± 8.26 ml/hour (Mean ± SD) and in group B it was 70.73 ± 11.01 ml/hour (Mean ± SD) which correspond to previous study of Song, et al [3]. The Acute Dialysis Quality Initiative (ADQI) work group introduced a multilevel classification system for AKI, RIFLE classification in 2004 [30]. This investigators group subsequently published AKIN (Acute Kidney Injury Network) criteria which discarded chronic criteria and estimated glomerular filtration rate (GFR) [31]. The same study group recently suggested KDIGO (kidney disease: improving global outcomes) criteria which added RRT and 12 hours of anuria as criteria for Stage 3 AKI. Biomarkers of renal injury have been extensively studied recently because these markers can provide early detection of AKI and prognostic value. Most frequently studied promising biomarkers are neutrophil gelatinase-associated lipocalin (NGAL) and interleukin-18 (IL-18) [32-35]. Serum cystatin C is also suggested to be a useful predictor of CS-AKI [36]. Devarajan, et al [37] reviewed the current status of the most promising of these novel AKI biomarkers, including NGAL, Kidney Injury Molecule-1 (KIM-1), and IL-18, and concluded that biomarker combinations are likely to improve our ability to predict AKI and its outcomes, and these studies are only beginning to surface. Preoperative serum creatinine in group A was 1.11 ± 0.15 mg/dl (Mean ±SD) and in group B was 1.12 ± 0.16 (Mean ±SD) which was not statistically significant (p = 0.499) which was similar to the study of Gao, et al [22]. In previous study Han, et al.[23] found significant difference in baseline serum creatinine among the tertiles (p<0.001). Postoperative serum creatinine in group A was 1.25 ± 0.25 mg/dl (Mean ±SD) and in group B was 1.34 ± 0.36 mg/dl (Mean ±SD) which was statistically significant (p = 0.002). Rise of serum creatinine in group A was 0.14 ± 0.21 mg/dl (Mean ±SD) and in group B was 0.22 ± 0.32 mg/dl (Mean ±SD) which was statistically significant (p = 0.016). Preoperative eGFR in group A was 71.22 ± 13.83 ml/min/1.73 m^2 (Mean ±SD) and in group B was 68.91 ± 17.29 ml/min/1.73 m^2 (Mean ±SD) which was not statistically significant (p<0.139). But previous studies showed significant difference in preoperative baseline eGFR Gao, et al.,[22]; Han, et al.,[23] which was dissimilar to our study. Postoperative eGFR in group A was 64.66 ± 15.86 ml/min/1.73 m^2 (Mean ±SD) and in group B was 60.07 ± 19.36 ml/min/1.73 m^2 (Mean ±SD) which was statistically significant (p<0.009). Percent of decrease of eGFR in group A was 4.94 ± 9.17 (Mean ±SD) and in group B was 6.51 ± 10.47 (Mean ±SD) which was not statistically significant (p = 0.186). Kumada, et al [27] showed incidence of AKI was 15.7% after OPCAB. Patients with hs-CRP > 9 mg/L had

significantly higher rate of AKI following percutaneous coronary intervention (PCI) – 17 vs.6%; p<0.001. In our study AKI in group A was 11 (5.4 %) and in group B was 33 (16.2%) when measured by serum creatinine and it was significant statistically (odds ratio [OR] 3.39; 95% confidence interval [CI] 1.66-6.91, p<0.001). In group A number of AKI patient was 4 (2%) and in group B it was 12 (5.9%) when measured by eGFR and it was significant statistically (odds ratio [OR] 3.13; 95% confidence interval [CI] 0.99-9.86, p=0.041). In group A number of AKI patient was 11 (5.4%) and in group B it was 37 (18.1%) when measured by both creatinine and eGFR which was significant statistically (odds ratio [OR] 3.89; 95% confidence interval [CI] (1.92-7.86), p<0.001). Han, et al [23] showed similar result. They found prevalence of AKI was increased in third tertile group (42.7%) compared with first tertile group (25.6%) after CABG. 1% to 5% of cardiac surgical patients develop renal failure requiring dialysis [25]. No patient required dialysis in our study, where as 16 (2.5%) patients in group A and 11 (4.38%) patients in group B required dialysis in the study population showed by Song, et al [3]. Postoperative ICU stay was ≤3 days in 191(93.63%) patients of group A and 186 (91.18%) patients of group B. Only 13 (6.37) patients of group A and 18 (8.82) patients of group B, had to stay >3 days in ICU, which was not statistically significant (p=0.999). Postoperative hospital stay was ≤14 days in 203 (99.5%) patients of group A and 203 (99.5%) patients of group B. Only 1 (0.5%) patients of group A and 1(0.5%) patients of group B, had to stay >14 days in hospital after operation, which was not statistically significant (p = 0.999). Han, et al.[23] found significant difference regarding postoperative ICU stay, postoperative hospital stays and in-hospital mortality which were dissimilar to our study. Pearson correlation of quantitative variables with CRP showed only preoperative eGFR (p=0.023) was found correlated with preoperative CRP level. Multivariate logistic regression analyses were done to find out independent risk factor for AKI. It was found that preoperative high baseline CRP level (>3 mg/L) was independent risk factor for AKI (OR = 3.650, 95% C.I. for Odds Ratio was 1.782-7.474, p<0.001). During the hospital course no patient died nor required dialysis.

CONCLUSION

Postoperative AKI depends on many risk factors like poor LVEF, CPB, OPCAB itself, diabetes mellitus, hypertension and of course preoperative high baseline CRP. This prospective cohort study showed that preoperative high normal (3 to 6 mg/L) level of CRP increases the risk of AKI after OPCAB. This study suggests that preoperative CRP may be used as a predictor of AKI after OPCAB.

Limitations of the Study

Although the result of the study in respect to the clinical outcome revealed statistically significant and support the hypothesis there were some major limiting factors which might have affect the results. The study design was observational study and having some dissimilarity in the base line characteristics. Number of study population was limited.

Recommendations

We found that the incidence of AKI was higher in patient with preoperative high normal baseline CRP group than low normal CRP group after OPCAB. CRP level estimation is simple, affordable and widely available test like other routine investigations eg, TC, DC, ESR & Hb%, which are easily done in each and every patient admitted to hospital and should be included as a part of routine screening. Routine estimation of CRP is simple, cost effective and recommended to identify the patient with high risk of AKI after OPCAB. High CRP level is treatable; patient with high CRP level can be treated with empirical antibiotic, antilipidaemic, NSAIDs before an elective procedure like OPCAB. Preoperative CRP should be ≤ 3 mg/L to avoid AKI following OPCAB thus reducing morbidity in the OPCAB patients.

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