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Original Research Article

The influence of diabetes mellitus on acute renal damage following coronary artery bypass graft surgery

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ABSTRACT

Background: DM is a known risk factor for developing postoperative acute kidney injury (AKI) after Coronary Artery Bypass Grafting (CABG). Postoperative AKI is associated with increased short- and long-term morbidity and mortality. This study aims to comprehensively evaluate the impact of diabetes mellitus on the occurrence and severity of AKI following CABG.
Methods: This comparative cross-sectional study was carried out in the department of cardiac surgery, national institute of cardiovascular diseases (NICVD) on a total of 60 patients undergoing CABG. Postoperative serum creatinine was measured at 24 hours, 48 hours and 72 hours after surgery. Group A included 30 patients who were diabetic and Group B included 30 patients who were non-diabetic. Statistical analysis was performed using statistical package for social sciences (SPSS). A p value<0.05 was considered statistically significant.
Results: During the observation period overall, 16 (26.67%) out of 60 patients developed postoperative AKI with varying severity. Among them, 12 patients were from diabetic group and only 4 patients belonged to non-diabetic group (40% vs. 13.33%, p<0.020). Consequently, duration of ICU stays (7.87±4.98.12 vs 4.13±2.65 days, p<0.001) and length of postoperative hospital stay (7.88±2.92 vs 13.0±4.95 days, p<0.001) were also found to be significantly prolonged in group A patients.
Conclusion: The present study revealed that patients with diabetes mellitus were more susceptible to develop post CABG AKI in spite of having no pre-existing renal impairment.

Keywords: Diabetes Mellitus, Acute kidney injury, Coronary artery bypass grafting

INTRODUCTION

Ischemic heart disease is a condition in which there is an inadequate supply of blood and oxygen to a portion of the myocardium; it typically occurs when there's an imbalance between myocardial oxygen demand and supply. There is a strong association between ischemic heart disease (IHD) and diabetes mellitus (DM). People with diabetes are at a higher risk of developing IHD than those without diabetes. In fact, diabetes is considered one of the major risk factors for the development of IHD. Diabetes mellitus is associated with more extensive and diffuse atherosclerotic disease due to metabolic derangements and a proinflammatory and prothrombotic state.[1] The more severe and uncontrolled the diabetes, the greater the risk of renal dysfunction, peripheral vascular

disease, extensive coronary artery disease and congestive heart failure. Both invasive and noninvasive treatment is available to treat IHD.[2] Coronary artery bypass grafting (CABG) remains the most durable method of coronary revascularization available today. Among patients undergoing CABG, diabetes mellitus (DM) accounted for 20–50%, and the proportion has increased steadily over the last 15 years.[3]

Acute kidney injury (AKI) is one of the frequent postoperative complications after CABG. According to recent KDIGO guideline, recommendations similar to the AKIN and STS criteria, acute kidney injury (AKI) may be defined as increase in serum creatinine by ≥0.3 mg/dl (≥ 26.5 µmol/l) within 48 hours or increase in serum creatinine to ≥ 1.5 times baseline, which is known or presumed to have occurred within the prior 7 days or urine volume <0.5 ml/kg/h for 6 hours.[4] AKI is a frequent postoperative complication with an incidence ranging from 5 to 30% in patients undergoing cardiac surgery and 1% to 5% of cardiac surgical patients develop renal failure requiring dialysis.[5] DM is a known risk factor for developing postoperative acute kidney injury (AKI).[6]

Postoperative AKI is associated with increased short- and long-term morbidity and mortality. Furthermore, DM is one of the major causes of nephropathy following CABG surgery. Multiple mechanisms have been proposed as the cause of kidney damage after CABG. It is widely recognized that elevated blood sugar levels worsen kidney injury through various ways. Hyperglycemia can enhance oxidative stress and contribute to the intensification of injury caused by ischemia reperfusion.[7] IN addition, endothelial dysfunction induced by hyperglycemia can contribute to the pathogenesis of kidney injury.[7]

Understanding the intricate relationship between diabetes and AKI in the context of CABG is of paramount importance for several reasons. First, the prevalence of DM continues to rise, and with it, the number of diabetic patients undergoing CABG procedures. Secondly, the occurrence of AKI in diabetic patients undergoing CABG has been linked to increased duration of hospital stay, higher healthcare costs, and poorer long-term outcomes, highlighting the need for effective risk stratification and management strategies.[8] Strict control of DM during the perioperative period is mandatory for any surgical treatment and of course in case of cardiac surgery. Cardiac surgery is a stress for the patient which increase blood sugar level even in non-diabetic patients, so the diabetic patient is in great risk of having uncontrolled diabetes in postoperative period which may lead to AKI.[9]

This study aimed to comprehensively evaluate the impact of diabetes mellitus on the occurrence and severity of AKI following CABG. By elucidating the underlying pathophysiological mechanisms, identifying risk factors, and exploring potential preventive measures or interventions, this study intended to contribute valuable insights into optimizing the perioperative care of diabetic patients undergoing CABG.

METHODS

Study design

This was a cross-sectional comparative study conducted at the Department of Cardiac surgery, National Institute of Cardiovascular Diseases (NICVD), Sher-E-Bangla Nagar, Dhaka, Bangladesh from January 2022 to December 2023.A total number of 60 patients were included in this study who were allocated in two groups.

Group A

Diabetic patients who underwent CABG due to IHD.

Group B

Nondiabetic patients who underwent CABG due to IHD. Each group consisted of 30 patients.

Inclusion criteria

Patients admitted with IHD in the department of cardiac surgery, NICVD.

Exclusion criteria

Age<18 years & >70 years. Emergency CABG. Patients undergoing redo CABG. Preoperative hypotensive episode (systolic pressure <60 mmHg for more than 10 minutes). Patient with preoperative renal dysfunction (serum creatinine >1.4 mg/dl). Self-withdrawal of patient willfully/ who did not give consent.

All patients admitted with heart diseases in the department of cardiac surgery, NICVD, fulfilling the inclusion and exclusion criteria were considered for enrollment in this study after obtaining informed written consent. Meticulous history was taken, detailed clinical examination was performed and recorded in predesigned structured data sheet. Demographic data were recorded. A standard anesthetic protocol was used throughout the study. All the patients underwent standard median sternotomy and cardiac surgery under CPB was performed. During the procedure mean BP was kept >60 mmHg. Postoperatively patients were shifted to ICU and blood samples for serum creatinine level were collected at 24, 48, 72 hours after surgery. Urine output was monitored hourly. Any incidence of AKI was recorded according to KDIGO 2012 guideline.

Statistical analysis

Statistical analyses were performed using windows-based computer software devised with Statistical Packages for Social Sciences (SPSS-26) (SPSS Inc, Chicago, IL, USA). Descriptive and inferential statistical methods

were applied to analyze data. In descriptive statistics, continuous data was summarized by mean±SD. Categorical data was summarized into frequency distribution and percentage. To make comparison between groups and draw conclusions on data, several inferential statistics were used including Chi-square or Fisher's exact test for qualitative data and unpaired t-test for quantitative data. A p value of ≤0.05 was considered statistically significant.

RESULTS

Total 60 patients of coronary artery disease (CAD) who underwent CABG were enrolled in this study. Among them 30 patients (group A) were diabetic and other 30 patients (group B) were non-diabetic. There was no significant difference in demographic variables of the patients between two groups (Table 1). There was no significant difference in laboratory data among two groups except HbA1C% levels (8.59±3.92 vs 5.12±1.88). Difference of mean baseline serum creatinine was not statistically significant between two groups (1.12±0.48 mg/dl vs 0.88±0.65 mg/dl, p=0.053). But serum creatinine was significantly higher in group A patients compared to group B at 24 hours (1.80±1.03 mg/dl vs 1.43±0.49 mg/dl, p=0.036), 48 hours (1.68±0.98 mg/dl vs 1.31±0.44, p=0.030), 72 hours (1.57±0.86 mg/dl vs 1.25±0.26 mg/dl, p=0.026) p=0.023) after surgery. 16 patients developed postoperative AKI. Statistically significant difference was observed between the eGFR measured in ml/min/1.73m^2 between group A and group B at all the time points after surgery.

The incidence of AKI was significantly higher in group A than group B (40% vs 13.33%, p=0.020). Group A compared to group B had significantly longer length of ICU stay (7.87±4.98 vs 4.13±2.65 days, p<0.001) & postoperative hospital stay (12.09±5.90 vs 7.88±2.92 days, p<0.001). Mechanical ventilation time did not differ significantly (6.98±4.23 vs 6.11±3.84, p=0.203). There was no in hospital mortality. Three patients needed post-operative renal replacement therapy (RRT), among them 6.67% from group A & 3.33% from group B (p=0.307). The difference was not statistically significant.

Binary logistic regression analysis was done to assess predictors of early postoperative AKI. Multivariate logistic regression analysis identified only preoperative DM as an independent predictor of early postoperative AKI (p=0.041) with highest odds ratio (OR=13.752).

Table 1: Demographic variables of the patient.

	Group A, n=30	Group B, n=30	P value
Age (Mean±SD)	56.89±10.61	55.75±11.73	0.348
Sex			
Male	27 (90%)	28 (93.33%)	
Female	3 (10%)	2 (6.67%)	0.640
Co-morbidities			
Smoking	16 (53.33%)	21 (70%)	0.184
COPD	6 (20%)	4 (13.33%)	0.488
Hypertension	14 (46.67%)	17 (56.67%)	0.438
Dyslipidemia	16 (53.33%)	20 (66.67%)	0.292

Table 2: Comparison of perioperative serum creatinine and eGFR between two groups.

Post-operative outcome	Group A, n=30	Group B, n=30	P value
Need for RRT	1 (1.33%)	2 (6.67%)	0.554
In hospital mortality	0 (0%)	0 (0%)	1.0
ICU stay (days)	7.87±4.98	4.13±2.65	<0.001
Postop. hospital stay (days)	12.09±5.90	7.88±2.92	<0.001

Table 3: Comparison of post-operative clinical outcome (n=60).

Variables	OR	95 % CI	P value
DM	13.752	2.343-80.643	0.041
Duration of surgery	0.985	0.479-2.025	0.968
Use of CPB	0.450	0.254-1.072	0.065
COPD	0.084	0.223-7.552	0.771
Smoking	0.000	0.000	0.999
HTN	0.464	0.275-1.102	0.068
Dyslipidemia	0.971	0.477-2.128	0.955

DISCUSSION

Diabetes mellitus plays a significant role in influencing the occurrence and severity of post-coronary artery bypass grafting (CABG) acute kidney injury (AKI). Several factors contribute to this association. The present study evaluated the effect of DM in developing postoperative AKI after CABG operation.

Oezkur et al, conducted a study which included 928 patients who underwent CABG. Patients had a median age of 69 years, 73.9 % were male A history of diabetes was observed in 35 % of patients. Thirty-three (10.7 %) patients were operated with off-pump coronary artery bypass (OPCAB) and 2.6% (n=8) had on- pump beating heart procedure. A total of n=148 patients (49.3%) experienced AKI.10 In our study we found similar findings (40% vs. 13.33%).

Difference of mean baseline serum creatinine was not statistically significant between the two groups (1.12±0.48 mg/dl vs 0.88±0.65 mg/dl, p=0.053). But serum creatinine was significantly higher in diabetic patients compared to their non-diabetic counterpart at 24 hours (1.80±1.0 mg/dl vs 1.43±0.49 mg/dl, p=0.036). Similarly, postoperative eGFR was lower in diabetic group. At 24 hours of surgery eGFR was 57.62±5.20 ml/min/1.73m² vs. 60.15±7.27, p=0.049. At 48 (41.00±11.58 ml/min/1.73m^2 vs 55.24±13.32, p<0.001) and 72 hours (44.56±8.50 ml/min/1.73m^2 vs 53.83±14.28, p<0.001) the difference of eGFR showed significant variation. Same results were also observed by Vives et al.[11]

In 2020 Wang et al, conducted another study to assess the effect of DM on the outcomes of CABG in 4325 patients. He also showed DM patients on insulin has increased incidence of post-operative AKI after CABG. In our study, among the patients who developed postoperative AKI, total 3 patients required dialysis, 1 (1.33%) from group B and 2 (6.67%) from group A (p=0.554). Also, post-operative stay in hospital and ICU stay was more in group A which was statistically significant(p<0.05).12 All these findings coincide with the study conducted by Halkos et al.

Multivariate binary logistic regression analysis revealed that only preoperative diabetes mellitus was an independent determinant of post CABG AKI in our study (p= 0.041) with highest odds ratio (OR=13.752). There was no impact of dyslipidemia, HTN, smoking, COPD, operative time, number of grafts and use of cardiopulmonary bypass on post-operative AKI. These findings were also noted in previous studies.[13,14]

The present study had some limitations. The sample size was small. Besides the study was conducted in a single center for short duration. Further long-term multicenter study is required to provide a better outcome to the patients undergoing CABG.

CONCLUSION

The present study revealed that patients with diabetes mellitus were more susceptible to develop post CABG AKI in spite of having no pre-existing renal impairment. This group had significantly lower duration of postoperative ICU and hospital stay. So preoperative optimization of diabetic patients is necessary who are going for CABG for better outcome of the patients.

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REFERENCES

1. Gallagher S, Kapur A, Lovell MJ, Yaqoob MM. Impact of diabetesmellitus and renal insufficiency on 5-year mortality following coronary arterybypass graft surgery: a cohort study of 4869 UK patients. Eur J CardiothoracSurg. 2014;45(6):1075–81.6
2. Zarbock A, Schmidt C, Van Aken H, Wempe C, Martens S, Zahn PK, et al. Effect of remote ischemic preconditioning on kidney injury among high-risk patients undergoing cardiac surgery: a randomized clinical trial. JAMA. 2015;313:2133-41.
3. Yousefshahi F, Fakhre YAM, Barkhordari K, Amini M, Salehi OA, Rezaei HM, et al. Incidence and complications of acute kidney injury following coronary artery bypass graft: a retrospective cohort study. Iran J Kidney Dis. 2015;9:113–8.
4. Khwaja A. KDIGO clinical practice guidelines for acute kidney injury. Nephron Clinical Practice.2012; 120(4):179-84.
5. Abdelmalak B, Knitte J, Abdelmalak JB, Dalton JE, Christiansen E, Foss J, et al. Preoperative blood glucose concentrations and postoperative outcomes after elective non-cardiac surgery: an observational study. British J of Anaesth. 2014;112(1):79-88.
6. Cevdet UK, Atike TK, Rezan A, Cagri D, Hakan P, Huseyin S, et al. Hemoglobin A1c levels predicts acute kidney injury after coronary artery bypass surgery in non-diabetic patients. Brazilian J Cardiov Surg. 2017;32(2):83-9.
7. Hertzberg D, Sartipy U, Hershey E, Holzmann MJ, Stockholm S. Type 1 and type 2 diabetes mellitus and risk of acute kidney injury after coronary artery bypass grafting. American Heart J. 2015;170(5):895–902.
8. Mehmet O, Martin W, Dirk W, Jens HK, Christoph S, Christoph R, Victoria R, et al. Chronic hyperglycemia is associated with acute kidney injury in patients undergoing CABG surgery–a cohort study. BMC Cardiovascular Disorders. 2015;15(41):121-65.
9. Hertzberg D, Sartipy U, Hershey E, Holzmann MJ aStockholm, S. Type 1 and type 2 diabetes mellitus and risk of acute kidney injury after coronary artery

bypass grafting. American Heart J. 2015;170(5):895–902.
10. Oezkur M, Wagner M, Weismann D, Krannich JH, Schimmer C, Riegler C, Rücker V, et al. Chronic hyperglycemia is associated with acute kidney injury in patients undergoing CABG surgery–a cohort study. BMC Cardiovascular Disorders. 2015;15(1):1-6.
11. Vives M, Hernandez A, Parramon F, Estanyol N, Pardina B, Muñoz A, Alvarez P. Acute kidney injury after cardiac surgery: prevalence, impact and management challenges. International J of Nephrol and Renovasc Dis. 2019;23(4):153-66.
12. Wang R., Zhang H., Zhu Y., Chen W. and Chen X. The impact of diabetes mellitus on acute kidney injury after coronary artery bypass grafting. J Cardiothor Surg. 2020;15(1):1-8.
13. Wetzel S, Sarker M, Hasan M, Talukder A, Sudharsanan N. Rapidly rising diabetes and increasing body weight: A counterfactual analysis in repeated cross-sectional nationally representative data from Bangladesh. Epidemiol. 2023;16(4)1090-7.
14. Libby P, Stone PH, Boden WE. Fundamental pathobiology of coronary atherosclerosis and clinical implications for chronic ischemic heart disease management—the plaque hypothesis: a narrative review. JAMA Cardiol. 2017;8(2):192-201.

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