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Original Article

Coronary artery bypass grafting in non-dialysis dependent chronic renal disease

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Abstract

Background: Renal impairment is associated with increased morbidity and mortality after coronary artery bypass grafting (CABG). Therefore, we aimed to study the risk factors of increased morbidity and mortality after CABG in patients with non-dialysis-dependent mild-to-moderate chronic kidney disease.

Methods: This prospective study included 50 patients with non-dialysis-dependent renal impairment (renal disease stage II or III) with off-pump (n= 25) or on-pump (n= 25) CABG. Postoperative outcomes and creatinine levels were compared between both groups.

Results: The mean age of all patients was 48.4±12.3 years, and females presented 54% (n= 27). There were no differences in postoperative myocardial infarction (P= 0.923), atrial fibrillation (P= 0.776), blood transfusion (P=0.794), and ICU (P=0.772) and hospital stay (P= 0.698) between groups. Mechanical ventilation was longer in patients with on-pump CABG (16.4 ± 10.9 vs. 6.1 ± 3.2 hours; P<0.001). Creatinine levels were significantly lower in patients who had off-pump CABG (P<0.001). The cumulative mortality hazard increases to 56.7% in patients with preoperative creatinine levels above 2 mg/dl.

Conclusion: High preoperative creatinine levels could increase mortality in patients undergoing CABG. Off-pump CABG could be a better approach in patients with mild to moderate renal dysfunction.

KEYWORDS

Coronary artery bypass grafting; Chronic kidney diseases; On-pump; Off-pump coronary artery bypass grafting

Article History

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Introduction

Coronary artery bypass grafting (CABG) in patients with renal impairment is associated with increased morbidity and mortality. Serum urea is a risk factor for cardiac disease, and cardiovascular complications are common in patients with chronic kidney disease (CKD) [1]. On the other side, cardiac surgery is a risk factor for renal impairment in high-risk patients with borderline renal function. Preoperative renal impairment could be associated with an increased risk of hospital complications and prolonged stay [2].

The preoperative renal impairment stage associated with increased postoperative complications is still debatable [3]. In non-dialysis-dependent renal patients, the 5-year mortality was 50% after CABG, and data about the associated morbidity are scarce [4].

Durmaz and associates studied 93 patients with moderate renal affection and found that preoperative serum creatinine levels above 2.5 mg/dl predicted postoperative dialysis, prolonged stay, and mortality after CABG [5]. Therefore, we aimed to study the risk factors of increased

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morbidity and mortality after CABG in patients with non-dialysis-dependent mild-to-moderate chronic renal disease.

Patients and Methods

Design and patients

We prospectively studied 50 non-dialysis-dependent patients who had CABG from October 2018 to June 2020. Patients were divided into two groups: Group A (n= 25) had on-pump CABG and Group B (n= 25) had off-pump CABG. Staging of renal impairment was done according to the National Kidney Foundation (NKF) [6].

This study was conducted after the approval of the Human Ethics Committee of our institute (No. of the ethical approval letter: 2018/CTS/28). Written consent was taken from all patients before recruitment. We included patients aged 20-60 with a non-dialysis-dependent renal impairment who underwent isolated CABG. We excluded emergency cases, patients with a concomitant procedure, and those with stage I, VI, and V CKD. Additionally, patients with severe liver dysfunction were also excluded from our study.

Data and techniques

We collected preoperative patients' characteristics and comorbidities. Preoperative Imaging included renal ultrasound, echocardiography, and CT chest with contrast. Preoperative and postoperative echocardiography were compared for all patients. Postoperative echocardiography was done within two weeks and after three months.

The venous and arterial bypass grafts were harvested using heparin (300 U/kg) through median sternotomy as an incision of choice. Standard normothermic CPB was performed in patients who underwent on-pump CABG. A nasopharyngeal probe was used to monitor the temperature.

In patients who underwent off-pump CABG, a myocardial coronary artery stabilizer system was used in all cases. Revascularization of the left anterior descending artery (LAD) was done first. The distal and proximal end of the vessel was stabilized using polypropylene (0/5). The left internal mammary artery (LIMA)–LAD anastomosis was performed on the beating heart. After that, the distal anastomoses were performed using the coronary stabilizer.

We reported the total operative time, intraoperative or postoperative blood loss, and the need for blood transfusion.

Postoperative follow-up included the intensive care unit (ICU) duration and total hospital stay. Complications such as arrhythmias, cerebrovascular accidents, thromboembolism, infection, myocardial infarction, and mortality were recorded.

Statistical analysis:

Data were fed to the computer and analyzed using IBM SPSS software package version 20 (IBM Corp, Armonk, NY, USA). Qualitative data were described using numbers and percentages, and quantitative data as mean and standard deviation. The t-test, Chi-squared, and Fisher exact tests were used as appropriate. A P-value of less than 0.05 was considered statistically significant.

Results

Preoperative data

The mean age of all patients was 48.4 ±12.3 years, and 27 were females (54%). Stage II CKD patients were diagnosed in 56% of included patients (13 cases of Group A and 15 in Group B), and Stage III CKD was diagnosed in 44% of included patients (12 cases of Group A and 10 cases of Group B). (Table 1)

Table 1: Preoperative patients' characteristics. Continuous data were presented as mean and standard deviation, and categorical data as numbers and percentages

Parameters	(n= 50)
Age (years)	48.4 ±12.3
Gender	
Male	23 (46%)
Female	27 (54%)
Chronic kidney disease	
Stage II	28 (56%)
Stage III	22 (44%)
Hypertension	44 (88%)
Diabetes Mellitus	15 (30%)

Table 2: Comparison of the clinical outcomes in patients with renal impairment who had on-pump (Group A) vs. Off-pump (Group B) coronary artery bypass grafting. Continuous data were presented as mean and standard deviation, and categorical data as numbers and percentages

Clinical outcome	Group A (n= 25)	Group B (n= 25)	P-value
Myocardial infarction	1 (4%)	1 (4%)	0.923
Atrial fibrillation	5 (20%)	3 (12%)	0.776
Stroke	1 (4%)	0	0.849
Wound infection	2 (8%)	1 (4%)	0.998
Blood units (n)	2.1 ± 1.2	1.7 ± 1.5	0.794
Mechanical ventilation time (hours)	16.4 ± 10.9	6.1 ± 3.2	<0.001
Re-exploration for bleeding	2 (8%)	1 (4%)	0.998
Re-exploration for graft occlusion	0	1 (4%)	0.849
ICU stay (days)	3 ± 0.1	2.2 ± 0.3	0.772
Hospital stay (days)	12.2 ± 3.3	13.1 ± 2.9	0.698

ICU = intensive care unit

Operative and postoperative data

Atrial fibrillation occurred in 5 cases in Group A and 3 in Group B. One patient had a myocardial infarction in each group, wound infection occurred in 2 cases in Group A and one in Group B, and one patient in Group A had a stroke that led to death. The mean units of blood transfusion were 2.1 ± 1.2 vs. 1.7±1.5 units in Group A and B, respectively. Mechanical ventilation time was significantly higher in Group A. Re-exploration for bleeding occurred in 2 patients in Group A, and one case in Group B. Re-exploration for graft occlusion occurred in one case in Group B. The mean ICU stay was 3 ± 0.1 vs. 2.2 ± 0.3 days, and hospital stay was 12.2 ± 3.3 vs. 13.1 ± 2.9 days in Group A vs. B. (Table 2)

Renal function

Kidney specific tests (serum creatinine, BUN, Creatinine clearance) were compared between both groups. The changes in serum creatinine levels are shown in Figure 1 and 2. Creatinine levels were significantly lower in patients with off-pump CABG (P<0.001).

The association between mortality and preoperative creatinine

The mortality rate was higher with higher preoperative creatinine levels. The cumulative mortality hazard increases to 56.7% in patients with preoperative creatinine levels above 2 mg/dl.

Discussion

The most reliable measure for renal functions is the serum level of creatinine; however, it is not as accurate as the glomerular filtration rate. Cardiac patients with non–dialysis-dependent renal insufficiency had increased mortality and morbidity [7]. Patients with elevated preoperative serum creatinine are at higher risk of increased morbidity and mortality and need postoperative mechanical renal support [8].

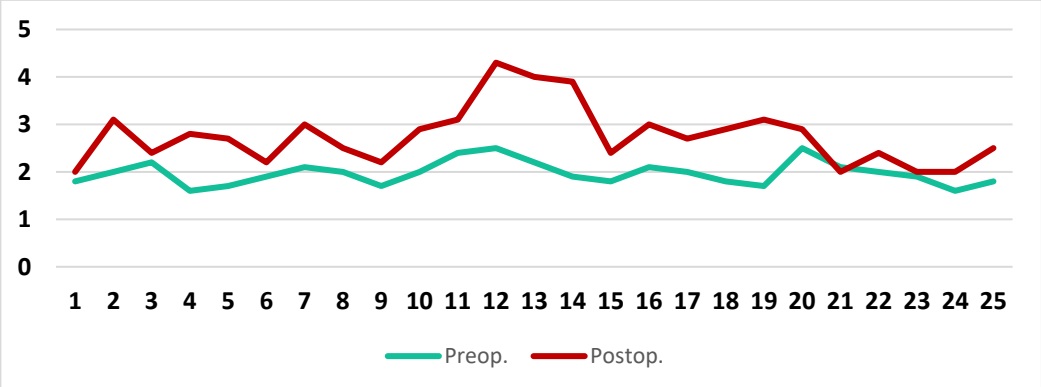

Figure 1: Pre and postoperative creatinine level in On-pump group

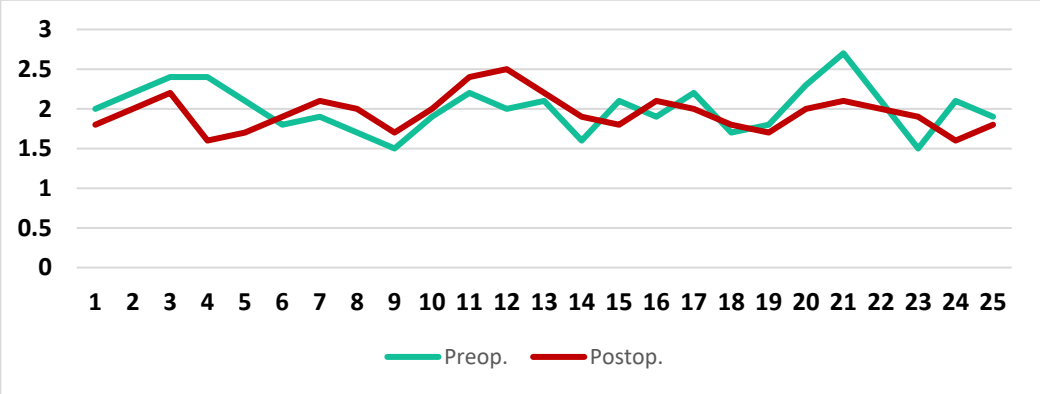

Figure 2: Pre and postoperative creatinine level in Off-pump group

Our results showed higher mortality rates in renal impaired patients who underwent CABG. Previous research on CABG patients with preoperative elevation of serum creatinine level showed that an increase of 1 mg/dl in the preoperative creatinine level increases hospital mortality postoperatively with more critical care complications [9]. Another study found an effect of serum creatinine on morbidity and mortality independent of other risk factors, such as age, the duration of cardiopulmonary bypass, and intensive care plus preoperative left ventricular function [10].

Detection of the factors responsible for higher postoperative creatinine levels in patients undergoing CABG showed that there are expected higher 20% at least in the postoperative serum creatinine level. This could explain that these patients are more liable to have more glomerular affection affecting the total renal function. This could add risk to the patient's life, either intraoperative or postoperative [11].

Patients undergoing CABG usually have another risk factor for renal impairment, such as hypertension, which may cause hypertensive glomerular sclerosis. The higher increase in creatinine levels in patients diagnosed with angina with New York Heart Association class III or greater is likely to develop more renal affection. Elevated postoperative levels of serum creatinine had a risk of longer cardiopulmonary bypass. Hemolysis related to longer periods on the cardiopulmonary bypass increases the rate of acute renal affection by the effect of hemoglobinuria [4,11].

This work studies the morbidity and mortality rate in patients who underwent CABG but also had mild to moderate elevation in the preoperative creatinine levels. The factors that affect renal function were also studied. The postoperative creatinine levels were lower in patients who underwent off-pump CABG compared to on-pump CABG. We also reported a higher mortality rate in patients with higher creatinine levels.

Limitations of the study:

The main limitation of this work is the small number of patients and the single-center experience. Another limitation is the lack of randomization; patient assignment to each group could be related to patients' characteristics. A randomized controlled trial is recommended.

Conclusion

High preoperative creatinine levels could lead to increased mortality in patients undergoing CABG. Off-pump CABG could be a better approach in patients with mild to moderate renal dysfunction.

Conflict of interest: Authors declare no conflict of interest.

References

1. Bhattacharya S. Outcomes of off-pump coronary artery bypass grafting in non-dialysis-dependent patients with stage 2 and stage 3 chronic kidney disease. Indian J Thorac Cardiovasc Surg. 2021; 34: 345-9.
2. Weerasinghe A, Hornick P, Smith P, Taylor K, Ratnatunga C. Coronary artery bypass grafting in non–dialysis-dependent mild-to-moderate

renal dysfunction. J Thorac Cardiovasc Surg. 2001; 121: 1083-9.
3. Rao V, Weisel RD, Buth KJ, et al. Coronary artery bypass grafting in patients with non-dialysis dependant renal insufficiency. Circulation. 1997; 96 (Suppl): II-38- 45.
4. Sajja LR, Singh S, Mannam G, Guttikonda J, Pusapati VRR, Saikiran KVSS. Impact of occult renal disease on the outcomes of off-pump and on-pump coronary artery bypass grafting. Indian J Thorac Cardiovasc Surg. 2019; 35: 150–7.
5. Durmaz I, Buket S, Atay Y, et al. Cardiac surgery with cardiopulmonary bypass in patients with chronic renal failure. J Thorac Cardiovasc Surg. 1999; 118: 306- 15.
6. Levey AS, Coresh J, Balk E. National Kidney Foundation. National Kidney Foundation Practice Guidelines for Chronic Kidney Disease: evaluation, classification, and stratification. Ann Intern Med. 2003; 139: 137–47
7. Owen CH, Cummings RG, Sell TL, Schwab SJ, Jones RH, Glower DD. Coronary artery bypass grafting in patients with dialysis-dependent renal failure. Ann Thorac Surg. 1994; 58: 1729-33.
8. Ashraf SS, Shaukat N, Kamaly ID, Doran B, Grotte GJ, Keenan DJ. Determinants of early and late mortality in patients with endstage renal disease undergoing cardiac surgery. Scand J Thorac Cardiovasc Surg. 1995; 29: 187-93.
9. Anderson RJ, O'Brien M, MaWhinney S, et al. Renal failure predisposes patients to adverse outcome after coronary artery bypass surgery. Kidney Int. 1999; 55: 1057-62.
10. Buckalew VM. Pathophysiology of progressive renal failure. South Med J. 1994; 87: 1028-33.
11. Hansbro SD, Sharpe DA, Catchpole R, et al. Haemolysis during cardiopulmonary bypass: an in vivo comparison of standard roller pumps, nonocclusive roller pumps and centrifugal pumps. Perfusion. 1999; 14: 3-10.