

# Association of Preoperative HbA1c Level with Incidence of New-Onset Atrial Fibrillation during Early Postoperative Period after On-Pump Coronary Artery Bypass Grafting Surgery in Diabetic Patients

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## Abstract

## Original Research Article

**Introduction:** Atrial fibrillation (AF) is a common complication following coronary artery bypass grafting (CABG) surgery, particularly in diabetic patients. Elevated preoperative HbA1c levels have been suggested as a potential risk factor for postoperative AF; however, the association remains unclear. This study aimed to investigate the association between preoperative HbA1c levels and the incidence of new-onset atrial fibrillation during the early postoperative period in diabetic patients undergoing on-pump CABG surgery in Bangladesh. **Methods:** This observational cross-sectional study was conducted at the Department of Cardiac Surgery, National Institute of Cardiovascular Disease, Dhaka, Bangladesh. A total of 60 diabetic patients undergoing on-pump CABG were included and divided into two groups: Group-1 (HbA1c <7%, n=30) and Group-2 (HbA1c ≥7%, n=30). Data were collected using a preformed data collection sheet, and statistical analysis was performed using the chi-square test, Fisher's test, and student's t-test. **Result:** In this study, Group-1 (HbA1c <7%) consisted of 30 patients, while Group-2 (HbA1c ≥7%) also comprised 30 patients. The mean age of Group-1 was 58.50±6.80 years, and that of Group-2 was 50.53±6.01 years (p < 0.001). The distribution of preoperative variables such as single, double, and triple vessel disease, hypertension, history of antiarrhythmic drug use, and NYHA class III and IV showed no significant differences between the groups (p > 0.05). However, preoperative HbA1c levels were significantly different between the two groups (6.11±0.44 in Group-1 vs. 7.98±0.55 in Group-2, p < 0.001). The incidence of new-onset atrial fibrillation during the early postoperative period was significantly higher in Group-2 (63.33%) than in Group-1 (30.00%, p < 0.05). A significant association was also observed between postoperative atrial fibrillation and hypertension (p < 0.05). Patients in Group-2 experienced a higher rate of postoperative complications, such as infection, bleeding, and prolonged ventilation; however, these differences were not statistically significant (p > 0.05). The only significant difference in postoperative complications was observed in the rate of patients with no complications, which was higher in Group-1 (76.67%) than in Group-2 (43.33%, p = 0.004). **Conclusion:** The findings of this study emphasize the importance of optimizing glycemic control and managing hypertension in diabetic patients prior to on-pump CABG surgery to reduce the risk of postoperative atrial fibrillation and other complications. Further research is needed to explore additional risk factors and develop strategies for the prevention and management of postoperative atrial fibrillation in this patient population.

**Keywords:** Coronary, Atrial, Fibrillation, Bypass, Artery, Grafting.

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## INTRODUCTION

Coronary artery disease (CAD) is a global health concern, and it is the leading cause of morbidity and mortality worldwide [1]. In Bangladesh, CAD has been identified as one of the major causes of death,

accounting for over 10% of total deaths in the country [2]. One of the most effective treatments for CAD is coronary artery bypass grafting (CABG) surgery, which helps restore normal blood flow to the heart by bypassing blocked coronary arteries [3]. Diabetes mellitus (DM) is a significant risk factor for CAD, with

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a higher prevalence among the Bangladeshi population, affecting approximately 9.7% of adults [4]. This highlights the importance of studying the impact of diabetes on CABG outcomes in Bangladesh. Glycated hemoglobin (HbA1c) is a widely accepted marker of long-term glycemic control in diabetic patients, and its level has been linked to various postoperative complications, including infections, poor wound healing, and prolonged hospital stay [5]. However, the association between preoperative HbA1c levels and the incidence of new-onset atrial fibrillation (AF) in the early postoperative period after CABG surgery remains unclear. AF is a common complication following CABG, with an incidence rate ranging from 15% to 40% [6]. Postoperative AF is associated with increased morbidity, mortality, and healthcare costs, making it a significant concern for clinicians and researchers [7]. There are two primary techniques for CABG surgery: off-pump and on-pump. Off-pump CABG, also known as beating heart surgery, is performed without the use of a cardiopulmonary bypass (CPB) machine. In contrast, on-pump CABG involves the use of a CPB machine to take over the function of the heart and lungs during surgery, allowing the heart to be temporarily stopped [8]. Both techniques have unique advantages. Off-pump CABG has been associated with a reduced risk of postoperative complications, shorter intensive care unit (ICU) stays, and decreased transfusion requirements [9]. On the other hand, on-pump CABG offers a more stable surgical field and better myocardial protection, making it suitable for patients with more complex coronary anatomy [10]. In Bangladesh, on-pump CABG is the more commonly performed technique due to its suitability for a broader range of patients [11]. While a few studies have investigated the association between preoperative HbA1c levels and the incidence of new-onset AF in diabetic patients undergoing CABG, the evidence is limited and inconsistent [1, 12, 13]. Moreover, there is a paucity of data focusing specifically on the Bangladeshi population, which has unique demographic and clinical characteristics that may impact the relationship between HbA1c and postoperative AF. Thus, the aim of this study is to investigate the association between preoperative HbA1c levels and the incidence of new-onset AF during the early postoperative period in diabetic patients

undergoing on-pump CABG surgery in Bangladesh. This study will contribute to the existing body of knowledge and potentially help clinicians identify high-risk patients who may require targeted interventions to reduce the risk of postoperative AF.

## METHODS

This observational cross-sectional study was conducted at the Department of Cardiac Surgery, National Institute of Cardiovascular Disease, Dhaka, Bangladesh. The study duration was 1.5 years, from April 2021 to September 2022. During this period, a total of 60 diabetic patients, undergoing on-pump coronary artery bypass surgery were included in the study following inclusion and exclusion criteria. Diabetic patients selected for on-pump coronary artery bypass surgery with sinus rhythm and aged between 30 to 70 years were included in the study. Patients aged <30 years or over 70 years, patients with Left ventricular systolic dysfunction (LVEF <35%), history of use of antiarrhythmic device or drugs except beta blocker, emergency surgery, redo surgery, and conversion to off-pump CABG were excluded from the study. Informed consent was obtained from the study participants prior to data collection, and ethical approval regarding the study was also obtained from the ethical review committee of the study hospital. The 60 patients were divided into 2 groups for better comparison, Group-1 containing 30 patients with HbA1c <7%, while Group-2 also comprised of 30 patients with HbA1c ≥7%. Meticulous history and detailed clinical examination findings were recorded in a predesigned structured format. Preoperative HbA1c levels were measured using Beckman Coulter Au480. Data were collected using a preformed data collection sheet from history, clinical examination, and laboratory investigations. All data were compiled, screened, and checked and entered into a computer to create a data file. The statistical package for the social sciences (SPSS) software (version-22) was used to evaluate all data. Chi-square test, Fisher's test & student's t-test were used for data analysis.

## RESULTS

**Table 1: Distribution of participants by age range (N=60)**

Age Distribution	Group-1 (n=30)		Group-2 (n=30)		p-value
	n	%	n	%	
41-50	5	16.67%	19	63.33%	<0.001
51-60	14	46.67%	9	30.00%	
61-70	11	36.67%	2	6.67%	
<b>Mean±SD</b>	58.50±6.80		50.53±6.01		

The distribution of participants by age range showed significant differences between Group-1 and Group-2 ( $p < 0.001$ ). In Group-1, 16.67% (n=5) of the participants were aged 41-50 years, 46.67% (n=14) were aged 51-60 years, and 36.67% (n=11) were aged

61-70 years. In contrast, in Group-2, the majority of the participants (63.33%, n=19) were aged 41-50 years, 30.00% (n=9) were aged 51-60 years, and only 6.67% (n=2) were aged 61-70 years. The mean age for Group-

1 was 58.50±6.80 years, while for Group-2, it was 50.53±6.01 years.

**Table 2: Distribution of participants by preoperative variables (N=60)**

Variables	Group-1 (n=30)		Group-2 (n=30)		p-value
	n	%	n	%	
Preoperative HbA1c	6.11±0.44		7.98±0.55		<0.001
Single vessel disease	2	6.67%	1	3.33%	>0.05
Double vessel disease	9	30.00%	3	10.00%	
Triple vessel disease	19	63.33%	26	86.67%	
Hypertension	5	16.67%	6	20.00%	>0.05
H/O anti arrhythmic drug	3	10.00%	5	16.67%	>0.05
NYHA Class III	23	76.67%	22	73.33%	>0.05
NYHA Class IV	7	23.33%	8	26.67%	

The distribution of participants by preoperative variables showed a significant difference in preoperative HbA1c levels between Group-1 and Group-2 ( $p < 0.001$ ), with means of 6.11±0.44 and 7.98±0.55, respectively. No significant differences were observed between the two groups for the other preoperative variables ( $p > 0.05$ ). In Group-1, 6.67% (n=2) of the participants had single-vessel disease, 30.00% (n=9) had double-vessel disease, and 63.33% (n=19) had triple-vessel disease, whereas in Group-2, 3.33% (n=1) had single-vessel disease, 10.00% (n=3)

had double-vessel disease, and 86.67% (n=26) had triple-vessel disease. Hypertension was observed in 16.67% (n=5) of Group-1 participants and 20.00% (n=6) of Group-2 participants. A history of anti-arrhythmic drug use was reported in 10.00% (n=3) of Group-1 participants and 16.67% (n=5) of Group-2 participants. In terms of NYHA classification, 76.67% (n=23) of Group-1 and 73.33% (n=22) of Group-2 participants were classified as Class III, while 23.33% (n=7) of Group-1 and 26.67% (n=8) of Group-2 participants were classified as Class IV.

**Table 3: Distribution of participants by incidence of atrial fibrillation (AF) (N=60)**

Incidence of AF	Group-1 (n=30)		Group-2 (n=30)		p-value
	n	%	n	%	
Yes	9	30.00%	19	63.33%	<0.05
No	21	70.00%	11	36.67%	

The distribution of participants by the incidence of atrial fibrillation (AF) showed a significant difference between Group-1 and Group-2 ( $p < 0.05$ ). In Group-1, 30.00% (n=9) of the participants experienced

postoperative atrial fibrillation, while 70.00% (n=21) did not. In contrast, in Group-2, 63.33% (n=19) of the participants experienced postoperative atrial fibrillation, and 36.67% (n=11) did not.

**Table 4: Association of Postoperative arterial fibrillation by hypertension among the participants (N=60)**

Hypertension	Postoperative AF				p-value
	Yes		No		
	Group-1 n (%)	Group-2 n (%)	Group-1 n (%)	Group-2 n (%)	
Yes	6 (20%)	15 (50%)	6 (20%)	3 (10%)	<0.05
No	3 (10%)	4 (13.333%)	15 (50%)	8 (26.67%)	

The association of postoperative atrial fibrillation by hypertension among the participants showed a significant difference ( $p < 0.05$ ). In hypertensive participants, 20.00% (n=6) from Group-1 and 50.00% (n=15) from Group-2 experienced postoperative atrial fibrillation, while 20.00% (n=6)

from Group-1 and 10.00% (n=3) from Group-2 did not. In non-hypertensive participants, 10.00% (n=3) from Group-1 and 13.33% (n=4) from Group-2 experienced postoperative atrial fibrillation, whereas 50.00% (n=15) from Group-1 and 26.67% (n=8) from Group-2 did not.

**Table 5: Distribution of the Study Participants by Postoperative Complications**

Variables	Group-1 (n=30)		Group-2 (n=30)		p-value
	n	%	n	%	
Infection	1	3.33%	4	13.33%	>0.05
Bleeding	2	6.67%	5	16.67%	>0.05
Prolonged Ventilation	3	10.00%	6	20.00%	>0.05
Stroke	1	3.33%	2	6.67%	>0.05
No Complications	23	76.67%	13	43.33%	<0.05

The distribution of the study participants by postoperative complications showed various differences between Group-1 and Group-2. Infection was observed in 3.33% (n=1) of Group-1 participants and 13.33% (n=4) of Group-2 participants, with a p-value of 0.16. Bleeding occurred in 6.67% (n=2) of Group-1 participants and 16.67% (n=5) of Group-2 participants, with a p-value of 0.21. Prolonged ventilation was required for 10.00% (n=3) of Group-1 participants and 20.00% (n=6) of Group-2 participants, with a p-value of 0.26. Stroke affected 3.33% (n=1) of Group-1 participants and 6.67% (n=2) of Group-2 participants, with a p-value of 0.55. The most notable difference between the two groups was observed in participants with no postoperative complications. A significantly higher proportion of Group-1 participants (76.67%, n=23) experienced no postoperative complications compared to Group-2 participants (43.33%, n=13), with a p-value of 0.004.

## DISCUSSION

The significant difference in age distribution between Group-1 and Group-2 ( $p < 0.001$ ) indicates that age may play a role in the incidence of postoperative atrial fibrillation (AF) in diabetic patients undergoing on-pump coronary artery bypass grafting (CABG) surgery. This observation aligns with previous studies that have reported age as an independent risk factor for developing postoperative AF [14,15]. The preoperative variables, including the severity of coronary artery disease, hypertension, history of anti-arrhythmic drug use, and NYHA classification, did not demonstrate significant differences between the two groups ( $p > 0.05$ ), except for preoperative HbA1c levels. The higher incidence of postoperative AF in Group-2 with elevated HbA1c levels ( $p < 0.05$ ) is consistent with previous research highlighting a positive association between elevated preoperative HbA1c levels and postoperative AF [16, 17].

The relationship between hypertension and postoperative AF is noteworthy. Our study found a significant association between hypertension and the incidence of postoperative AF, especially in Group-2 ( $p < 0.05$ ). This finding is supported by a meta-analysis that identified hypertension as an independent risk factor for developing postoperative AF in patients undergoing CABG [18]. The distribution of postoperative complications showed that Group-2 participants experienced a higher rate of complications, such as infection, bleeding, and prolonged ventilation, albeit not statistically significant ( $p > 0.05$ ). However, a significantly higher proportion of Group-1 participants experienced no postoperative complications compared to Group-2 participants ( $p = 0.004$ ), emphasizing the importance of better glycemic control in diabetic patients to reduce postoperative complications. When comparing our study findings with other research, some discrepancies were revealed. A study by Lohchab *et al.*

found that the incidence of postoperative AF in diabetic patients undergoing on-pump CABG was lower than in our study [19]. This difference may be attributed to varying sample sizes, patient demographics, and preoperative management strategies. Some studies suggested that the use of off-pump CABG might reduce the incidence of postoperative AF compared to on-pump CABG [20, 21]. However, the present study focused solely on patients undergoing on-pump CABG surgery.

## Limitations of the Study

The study was conducted in a single hospital with a small sample size. So, the results may not represent the whole community. Furthermore, our study did not investigate other risk factors for developing postoperative AF, such as obesity, left atrial size, renal dysfunction *etc.*

## CONCLUSION

The present study demonstrated a significant association between elevated preoperative HbA1c levels and the incidence of new-onset atrial fibrillation during the early postoperative period in diabetic patients undergoing on-pump coronary artery bypass grafting surgery. Additionally, hypertension was identified as a significant risk factor for postoperative atrial fibrillation. The study findings underscore the importance of optimizing glycemic control and managing hypertension in diabetic patients prior to CABG surgery to mitigate the risk of postoperative atrial fibrillation and other complications. Further research is warranted to investigate additional risk factors and to develop strategies for the prevention and management of postoperative atrial fibrillation in this patient population.

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