The Incidence of Atrial Fibrillation Post Coronary Artery Bypass Grafting Surgery

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Abstract

Background: **Atrial fibrillation (AF) is a rapid and irregular heart rhythm originating in the atria, characterized by electrical activity that disrupts effective atrial contraction. It is a common complication after cardiac surgery, particularly coronary artery bypass grafting (CABG), and, despite being mostly benign, it can increase morbidity and mortality.** ***Aim:*** **Identify risk factors for atrial fibrillation in CABG patients from Suez Canal University Hospitals and Ismailia Medical Complex, to improve surgical outcomes by reducing complications and mortality.** ***Patients and Methods:*** **This retrospective cohort study (October 2022 - October 2023) in 205 randomly selected CABG patients from Suez Canal University Hospitals and Ismailia Medical Complex** ***Results:*** **Postoperative atrial fibrillation (POAF) occurred in 21.9% of patients (Group 1 (POAF): 45 patients, Group 2 (non-POAF): 160 patients).** ***Conclusions:*** **AF is the most common arrhythmic complication after cardiac surgery. While typically benign, it increases morbidity, mortality, ICU stay duration, and hospital costs. The occurrence of POAF is associated with various risk factors; in our study, age, diabetes mellitus, large left atrial diameter, low ejection fraction, and right coronary artery (RCA) dominance were significant predictors of AF development after surgery.**

Keywords: Atrial fibrillation, coronary artery bypass grafting, and postoperative complications.

Introduction

Ischemic artery disease is one of main worldwide reasons of death. It has remained so for the past few many years and its international burden on healthcare structures is predicted to increase. It is responsible for the loss of life of multiple 0.33 of the persons in developing countries and almost ½ of deaths in western countries. Direct fees of overall cardiovascular illnesses are an amazing burden on healthcare structures worldwide, such as diagnostic procedures, fees of interventions and hospitalizations. Another side to this problem away from fees and mortality is quality of life. Angina pectoris, the most common presentation of coronary artery disease, is a completely crippling symptom. It impacts on the patients' physical status with marked issue in physical activity in addition to the patients' emotional and mental status leading to a completely bad quality of life [1,2].

Ischemic artery disease remains a leading cause of death globally, imposing a significant burden on healthcare systems due to treatment costs and reduced quality of life [2].

Angina pectoris, a common symptom, impacts on the patients' physical status with marked issues in physical activity in addition to the patients' emotional and mental status leading to a completely bad quality of life [3].

Coronary artery bypass grafting (CABG) is a widely used surgical method to restore blood flow. However, postoperative atrial fibrillation (POAF) is a frequent complication, occurring in 5-50% of cases, particularly within 2-4 days post-surgery.

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Though often considered benign, POAF increases morbidity, mortality, ICU stay duration, and healthcare costs [4].
This study compares patients with and without POAF to identify risk factors and improve surgical outcomes.

Materials and Methods

Study Design and Population

This retrospective cohort study included 205 patients who underwent isolated CABG between October 2022 and October 2023 at Suez Canal University Hospitals and Ismailia Medical Complex. Patients were divided into two groups based on the development of postoperative atrial fibrillation (POAF):
- **Group 1** (POAF): 45 patients who developed new-onset atrial fibrillation.
- **Group 2** (non-POAF): 160 patients who maintained sinus rhythm.

Patients with preoperative atrial arrhythmias, pacemakers, off-pump procedures, age over 70, or combined cardiac/vascular surgeries were excluded.

Data Collection

Preoperative data included demographic details (age, gender), vital signs, medical history (e.g., diabetes, hypertension), and investigations (ECG, echocardiography, coronary angiography). Intraoperative data covered graft numbers, cardiopulmonary bypass (CPB) time, and aortic cross-clamp time. Postoperative data tracked ICU/hospital stay, new-onset AF, and mortality.

Surgical Procedure

Patients underwent on-pump CABG with standard techniques: median sternotomy, left internal mammary artery (LIMA) and saphenous vein graft (SVG) harvesting, and anastomosis using cardioplegia for myocardial protection. Monitoring included arterial blood gases and ECG post-surgery.

Statistical Analysis

Data were analyzed using(SPSS version 20.0)with quantitative variables expressed as mean ± SD and qualitative data as frequencies. Logistic regression identified risk factors for POAF, with($p<0.05$)considered significant.

Ethical Considerations

Informed consent was obtained, and the study adhered to the Helsinki Declaration, allowing patients to withdraw at any time.

Results

205 cases were included in our study; These Patients were divided into two groups based on the development of postoperative atrial fibrillation (POAF): Group 1 (POAF): 45 patients who developed new-onset atrial fibrillation. Group 2 (non-POAF): 160 patients who maintained sinus rhythm.
Demographic analysis showed no significant gender or age differences (mean age: 58.91 ± 5.21 years for no POAF vs. 57.78 ± 6.55 for POAF, $p=0.291$) (Table 1).

Preoperative data analysis showed Smoking ($p=0.047$) and diabetes mellitus (DM, $p<0.001$) were significantly associated with POAF. Ejection fraction (EF) was lower in POAF patients (50.73 ± 9.94% vs. 58.88 ± 9.19%, $p<0.001$), while left atrial (LA) diameter showed no significant difference ($p=0.994$) (Table 2).
Operative data analysis showed Right coronary artery (RCA) dominance was a significant predictor ($p<0.001$), with 57.8% of POAF cases showing non-dominant RCA vs. 29.4% in non-POAF. No significant differences were noted in graft numbers, CPB time, or cross-clamp time ($p>0.05$) (Table 3).
Postoperative data analysis showed POAF patients had longer ICU stays (median 5 vs. 3 days, $p<0.001$) and hospital stays (median 9 vs. 7 days, $p<0.001$). Mortality was rare (1% overall), with no significant difference between groups ($p=0.392$) (Table 4)

Table 1: Demographic Data							
	Total (205)		POAF				p
			No (n = 160)		Yes (n = 45)		
	No.	%	No.	%	No.	%	
Gender							
Male	149	72.7	117	73.1	32	71.1	0.789
Female	56	27.3	43	26.9	13	28.9	
Age							
>60	134	65.4	106	66.3	28	62.2	0.616
<60	71	34.6	54	33.8	17	37.9	
Min. – Max.	44.0 – 69.0		44.0 – 69.0		45.0 – 69.0		0.291
Mean ± SD.	58.66 ± 5.53		58.91 ± 5.21		57.78 ± 6.55		

Table 2: Preoperative data in the studied groups								
Variable		Total (205)		POAF				p
				No (n = 160)		Yes (n = 45)		
		No.	%	No.	%	No.	%	
History	**Smoking**							
	No	86	41.9	60	37.5	26	57.8	0.047*
	Yes	119	58.0	100	62.5	19	42.2	
	DM	156	76.1	131	81.9	25	55.6	<0.001*
	HTN	147	71.7	112	70.0	35	77.8	0.306
	COPD	43	21.0	31	19.4	12	26.7	0.289
	CKD	18	8.8	13	8.1	5	11.1	0.554
ECHO finding	**LA diameter** Min. – Max. Mean ± SD.							0.994
		20.0 – 57.0		21.0 – 57.0		20.0 – 52.0		
		39.43 ± 6.28		39.43 ± 5.92		39.42 ± 7.50		
	EF % Min. – Max. Mean ± SD.							<0.001*
		34.0 – 78.0		34.0 – 78.0		35.0 – 68.0		
		57.09 ± 9.93		58.88 ± 9.19		50.73 ± 9.94		

Table 3: Operative Data in the studied groups							
	Total (n = 205)		POAF				p
			No (n = 160)		Yes (n = 45)		
	No.	%	No.	%	No.	%	
RCA dominance							
Non	132	64.4	113	70.6	19	42.2	<0.001
Dominant	73	35.6	47	29.4	26	57.8	
RCA grafting							
No	100	48.8	76	47.5	24	53.3	0.489
Yes	105	51.2	84	52.5	21	46.7	
Number of grafts							

Min. – Max.	1.0 – 5.0		1.0 – 5.0		1.0 – 4.0		0.511
Median (IQR)	2.0 (1.0 – 3.0)		2.0 (1.0 – 3.0)		3.0 (2.0 – 3.0)		
Cross Clamp Time (min)							
Min. – Max.	24.0 – 115.0		24.0 – 115.0		25.0 – 95.0		0.631
Median (IQR)	53.0 (35.0 – 74.0)		50.0 (34.0 – 75.0)		60.0 (38.0 – 72.0)		
Bypass Time (min)							
Min. – Max.	40.0 – 205.0		40.0 – 205.0		40.0 – 185.0		
Median (IQR)	88.0 (60.0 – 117.0)		85.0 (60.0 – 117.5)		103.0(70.0 – 115.0)		0.532
IABP							
No	200	97.6	157	98.1	43	95.6	0.302
Yes	5	2.4	3	1.9	2	4.4	

Postoperative data analysis showed POAF patients had longer ICU stays (median 5 vs. 3 days, p<0.001) and hospital stays (median 9 vs. 7 days, p<0.001). Mortality was rare (1% overall), with no significant difference between groups (p=0.392) (Table 4).

Table 4: Postoperative Data in the studied groups

	Total (n = 205)		POAF				p
			No (n = 160)		Yes (n = 45)		
	No.	%	No.	%	No.	%	
Reopening for bleeding							
No	199	97.1	155	96.9	44	97.8	1.000
Yes	6	2.9	5	3.1	1	2.2	
Mortality							
NO	203	99.0	159	99.4	44	97.8	0.392
Yes	2	1.0	1	0.6	1	2.2	
ICU stay days							
Min. – Max.	2.0 – 10.0		2.0 – 7.0		2.0 – 10.0		<0.001*
Median (IQR)	3.0 (2.0 – 4.0)		3.0 (2.0 – 4.0)		5.0 (4.0 – 6.0)		
Hospital stays (days)							
Min. – Max.	4.0 – 15.0		4.0 – 14.0		5.0 – 15.0		<0.001*
Median (IQR)	7.0 (6.0 – 8.0)		6.0 (5.50 – 7.0)		9.0 (8.0 – 10.0)		

Postoperative atrial fibrillation (POAF) occurred in 21.9% of patients, corresponding to 45 out of 205 patients who underwent isolated coronary artery bypass grafting (CABG) (Table 5).

Table 5: Incidence of Postoperative Atrial Fibrillation (POAF) After CABG Surgeries

POAF	Number	Percent
Yes	45	21.9%
No	160	78.1%
Total	205	100%

Logistic regression identified age >60 (OR 1.035, p=0.002), DM (OR 0.277, p=0.001), LA diameter (OR 1.618, p=0.011), low EF (OR 0.917, p=0.001), and RCA dominance (OR 3.290, p=0.001) as significant POAF predictors (Table 6).

Table 6: Logistic regression analysis of predictors of postoperative atrial fibrillation (POAF)			
Variable		Number of cases with POAF	
		No.	%
1) Demographic data:			
Gender	Male	32	71.1
	Female	13	28.9
Age	>60	28	62.2
	<60	17	23.8
2) Preoperative data:			
Smoking	No	26	57.8
	Yes	19	42.2
DM		25	55.6
HTN		35	77.8
COPD		12	26.7
CKD		5	11.1
LA diameter	<40 mm	19	42.2
	≥40 mm	26	57.8
EF %	≤50	28	62.2
	>50	17	37.8
3) Operative data:			
RCA dominance	Non	19	42.2
	Dominant	26	57.8
RCA grafting	No	24	53.4
	Yes	21	46.6
Cross Clamp Time (min)	≤60	23	51.1
	>60	22	48.9
Bypass Time (min)	≤110	28	62.2
	>110	17	37.8
Number of grafts	1	11	24.4
	2	11	24.4
	3	20	44.5
	4	3	6.7
	5	0	0.0
IABP	No	43	95.6
	Yes	2	4.4
4)Postoperative data:			
Reopening for bleeding	No	44	97.8
	Yes	1	2.2
ICU stay days	≤4	14	31.1
	>4	31	68.9
Hospital stays	≤8	13	28.9
	>8	32	71.1
Mortality	No	44	97.8
	Yes	1	2.2

Discussion

Postoperative atrial fibrillation (POAF) is the most common arrhythmia following cardiac surgery, with a rising incidence attributed to an aging surgical population. Reported incidence rates vary significantly (10–65%), reflecting differences in study design, patient demographics, and the definitions used for atrial fibrillation (AF). Approximately 30% of patients undergoing

coronary artery bypass grafting (CABG) develop POAF [5].

In our study, POAF occurred in 21.9% of patients (45 out of 205) following isolated CABG, consistent with prior reports. The Society of Thoracic Surgeons' most recent database documents a similar incidence of 24.9% for new-onset AF following CABG [6,7]. The role of off-pump CABG in reducing POAF incidence remains controversial. For example, one randomized controlled trial identified the use of cardiopulmonary bypass with cardioplegic arrest as the strongest independent predictor of POAF (OR 7.4, 95% CI: 3.4–17.9) [7]. However, the generalizability of this finding is limited by the small sample size and single-center design. Subsequent larger trials, including the ROOBY trial, reported similar POAF rates in both off-pump (27%) and on-pump groups, suggesting no significant protective benefit of the off-pump technique [8,9].

The pathophysiology of POAF is multifactorial, involving inflammatory, metabolic, and neurohormonal pathways that contribute to atrial electrical remodeling and the formation of reentrant circuits promoting irregular atrial activity.

POAF continues to be a prevalent postoperative complication associated with prolonged ICU stays, extended hospitalization, and increased healthcare costs. Our findings support previous evidence showing that patients who develop POAF have worse clinical outcomes and greater resource utilization compared to those who maintain sinus rhythm [10,11]. Targeted preventive strategies in high-risk patients may help reduce these burdens [11].

Among the 45 patients who developed POAF, advanced age (>60 years) is associated with an estimated 50% increase in the risk of POAF per decade [12,13] and male sex emerged as significant predictors, consistent with known mechanisms of atrial remodeling and documented gender-based differences in arrhythmogenesis [14].

The mean age at POAF onset in our cohort (58.91 ± 5.21 years) was lower than that reported in Western populations [15]. Notably, only 8.29% of cases occurred in patients younger than 60 years, who represented 34.6% of the cohort. Smoking, present in 42.2% of POAF patients, was a significant risk factor likely mediated through COPD-induced ventilation/perfusion mismatch, postoperative atelectasis, and hypoxemia [15,16].

Hypertension (present in 77.8% of POAF cases) and diabetes mellitus ($p<0.001$) were significant predictors. These findings are consistent with existing evidence: hypertension leads to atrial fibrosis and refractoriness dispersion [16], while diabetes promotes metabolic remodeling of atrial tissue [16]. The multifactorial pathogenesis of POAF includes structural remodeling (e.g. left atrial enlargement, left ventricular hypertrophy) and triggers such as ischemia, inflammation, and autonomic imbalance [17]. While most studies confirm these associations [17], some report no significant correlation between diabetes and POAF [7], highlighting the complex and multifactorial nature of the condition.

In our study, the left atrial diameter did not predict POAF ($p = 0.994$). However, reduced left ventricular ejection fraction (LVEF < 40%) and the presence of congestive heart failure (OR 2.1, 95% CI: 1.4–3.2; $p < 0.01$) were independent predictors. This may be due to atrial remodeling in CHF, characterized by prolonged P-wave duration (152 ± 18 ms vs. 118 ± 12 ms; $p < 0.001$) and increased conduction heterogeneity [18].

Although prolonged cardiopulmonary bypass and aortic cross-clamp times have been implicated in POAF pathogenesis via ischemia-reperfusion injury [18], our findings did not demonstrate a significant association. This may reflect the protective effects of current myocardial protection strategies [19]. Additionally, POAF was associated with prolonged ICU stays [18] and a fivefold increased thromboembolic risk [19,20], likely due to left atrial stasis [21]. In our study, the use of intra-aortic balloon pump

showed no significant influence on POAF incidence.

Conclusion

POAF remains a significant complication post-CABG, affecting 21.9% of patients in this cohort. Key predictors identified include advanced age, diabetes mellitus, low ejection fraction, and RCA dominance. Despite its benign nature, POAF increases morbidity and healthcare costs. Targeted interventions based on these risk factors could improve outcomes, though further multicenter studies are needed.

References

1. Abreu A, Máximo J, Leite-Moreira A. Long-term survival of single versus bilateral internal mammary artery grafting in patients under 70. *Interact Cardiovasc Thorac Surg* 2022;35(4):480–488.
2. Ahmed H. Thrombogenesis in atrial fibrillation. In: Atrial Fibrillation - Mechanisms and Treatment. 1st ed. London: IntechOpen; 2020:1–15.
3. Alexander JH. Preventing atrial fibrillation after cardiac surgery. *J Am Coll Cardiol* 2021;77(1):68–70.
4. AlSadawi M, Aleem S, Almasry I. Rhythm versus rate control for atrial fibrillation in heart failure with preserved ejection fraction. *Heart Rhythm O2* 2022;3(5):520–525.
5. Aydın U, Engin M, Cebeci GF, Ata Y. Postoperative atrial fibrillation occurring after coronary bypass graft surgery. *Braz J Cardiovasc Surg* 2023;38(3):353–360.
6. Hahn RT. Understanding the anatomy of the conduction system of the heart: Attitudinal is unnecessary. *Heart* 2023;109(10):728–729.
7. Heijman J, Linz D, Schotten U. Dynamics of atrial fibrillation mechanisms and comorbidities. *Annu Rev Physiol* 2021; 83:83–106.
8. Ivanovic S, Ramcharitar R, Rogal G. Amiodarone prophylaxis as prevention of post-cardiac surgery atrial fibrillation. *Chest* 2020;156(4):890–898.
9. Kawczynski MJ, Gilbers M, Van De Walle S. Role of pre-operative transthoracic echocardiography in predicting post-operative atrial fibrillation after cardiac surgery: A systematic review and meta-analysis. *Europace* 2021;23(11):1731–1743.
10. Lau DH, Maesen B, Zeemering S. Indices of bipolar complex fractionated atrial electrograms correlate poorly with each other and atrial fibrillation substrate complexity. *Heart Rhythm* 2020;12(7):1415–1423.
11. Mingalimova A, Nefedova G, Drapkina O. Predictors of atrial fibrillation developing in the hospital stage after coronary artery bypass surgery. *Kardiologiia* 2023;63(11):21–28.
12. Mostafa A, El-Haddad M, Shenoy M. Atrial fibrillation post cardiac bypass surgery. *Avicenna J Med* 2021;2(3):65–70.
13. Ngo L, Lee W, Elwashahy M, Arumugam P. Very long-term outcomes of patients undergoing catheter ablation of atrial fibrillation: A systematic review and meta-analysis. *Heart Lung Circ* 2022;31(12):1686–1698.
14. Pande S, Malhotra P, Mahindru S. Postoperative atrial fibrillation in coronary artery bypass grafting heralds a poor outcome. *Ann Card Anaesth* 2021;24(4):464–469.
15. Quin JA, Wagner TH, Hattler B, Carr BM. Ten-year outcomes of off-pump vs on-pump coronary artery bypass grafting in the Department of Veterans Affairs. *JAMA Surg* 2022;157(4):303–312.
16. Rafaqat S. Biomarkers of metabolic syndrome: Role in pathogenesis and pathophysiology of atrial fibrillation. *J Atrial Fibrillation* 2021;14(2):1–7.
17. Reed N, Brennan Z, Mandal K. Delayed aorto-atrial fistula: Rare complication of tricuspid valve endocarditis. *Indian J Thorac Cardiovasc Surg* 2023;40(1):111–113.
18. Sharma D. Postoperative atrial fibrillation after off-pump coronary artery bypass grafting. *Indian J Thorac Cardiovasc Surg* 2020;36(3):259.
19. Taggart DP, Gerry S, Gray A. Radial artery versus saphenous vein versus right internal thoracic artery for coronary artery bypass grafting: Different conduits or different trials? *Eur J Cardiothorac Surg* 2022;63(1):83–91.
20. Tempe DK, Maheshwari A, Fatima N. Role of magnesium alone or in combination with diltiazem and/or amiodarone in prevention of atrial fibrillation following off-pump coronary artery bypass grafting. *Ann Card Anaesth* 2023;26(4):399–404.

21. Van Wagoner DR, Chung MK. Inflammation, inflammasome activation, and atrial fibrillation. *Circulation* 2020;138(20):2243–2246.