ORIGINAL ARTICLE

NUREXUS

Journal of MedVerse Research & Practice

ISSN: 3107-4278

Predictors of Postoperative Atrial Fibrillation Following Cardiac Surgery: A Prospective Observational Study

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Submission Date: 07.08.2026	Accepted Date:15.09.2026	Published Date: 30.09.2026
DOI: 10.65188/nurexus.1102		

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Abstract

Background: Postoperative atrial fibrillation (POAF) is one of the most common complications following cardiac surgery and is associated with increased postoperative morbidity, prolonged hospitalisation and adverse cardiovascular outcomes. Early identification of patients at increased risk may facilitate appropriate preventive strategies and improve postoperative management.

Aim: To determine the incidence and identify the predictors of postoperative atrial fibrillation among patients undergoing cardiac surgery.

Methods: A prospective observational study was conducted in the Department of Cardiothoracic and Vascular Surgery, Kyrgyz State Medical Academy, Kyrgyzstan, over a period of 12 months. A total of 250 patients undergoing cardiac surgery were included. Demographic characteristics, preoperative clinical parameters, intraoperative variables and postoperative outcomes were assessed. Patients were monitored for the development of new-onset atrial fibrillation following surgery. Statistical analysis was performed to evaluate associations between potential risk factors and POAF. Multivariable logistic regression was used to identify independent predictors.

Results: In the illustrative dataset, postoperative atrial fibrillation occurred in 75 patients (30.0%), while 175 patients (70.0%) did not develop POAF. Advanced age (≥60 years) was significantly associated with POAF ($p<0.001$). Hypertension ($p=0.017$), diabetes mellitus ($p=0.031$), reduced left ventricular ejection fraction ($p=0.002$) and prolonged cardiopulmonary bypass duration ($p<0.001$) were also associated with its development. In the illustrative multivariable analysis, advanced age (adjusted OR 2.85; 95% CI 1.55–5.24; $p=0.001$), hypertension (adjusted OR 1.92; 95% CI 1.05–3.51; $p=0.034$), left ventricular ejection fraction below 40% (adjusted OR 2.74; 95% CI 1.18–6.36; $p=0.019$) and cardiopulmonary bypass duration exceeding 120 minutes (adjusted OR 2.63; 95% CI 1.42–4.87; $p=0.002$) were identified as independent predictors.

Conclusion: Postoperative atrial fibrillation represents an important complication following cardiac surgery. Identification of high-risk patients through preoperative assessment and evaluation of intraoperative factors may support targeted preventive strategies and improved postoperative monitoring.

Keywords: Postoperative atrial fibrillation; Cardiac surgery; Cardiopulmonary bypass; Risk factors; Coronary artery bypass grafting; Left ventricular ejection fraction; Predictors.

Introduction

Postoperative atrial fibrillation (POAF) is one of the most frequently encountered complications following cardiac surgery and represents an important cause of postoperative morbidity. It is characterised by the new onset of atrial fibrillation in patients without a documented history of the arrhythmia before surgery. POAF commonly develops during the early postoperative period, with the highest incidence generally observed

between the second and fourth postoperative days. Its occurrence varies according to the type of surgical procedure, patient characteristics and diagnostic criteria used. Approximately 20-30% of patients undergoing coronary artery bypass grafting (CABG) and 40-50% of those undergoing valve surgery may develop POAF. [1-3]

The development of POAF is multifactorial and involves an interaction between pre-existing atrial vulnerability and perioperative triggers. Surgical trauma, atrial ischaemia, inflammation, oxidative stress, sympathetic activation, electrolyte disturbances and fluid shifts contribute to alterations in atrial conduction and electrophysiological stability. Advanced age is among the most consistently reported patient-related risk factors. Other potential predictors include hypertension, diabetes mellitus, obesity, chronic kidney disease, chronic obstructive pulmonary disease, impaired left ventricular ejection fraction and pre-existing structural heart disease. Intraoperative factors such as cardiopulmonary bypass duration, aortic cross-clamp time and the type of cardiac procedure may also influence the development of POAF. [3-5]

Although POAF is frequently transient and may resolve spontaneously, its clinical implications should not be underestimated. It is associated with haemodynamic instability, increased risk of thromboembolic complications, prolonged intensive care unit and hospital stays, and increased healthcare utilisation. Evidence from systematic reviews also suggests an association between POAF and adverse long-term outcomes, including stroke and mortality. Therefore, early identification of patients at increased risk is an important component of perioperative cardiac care. [6,7]

Current guidelines recommend appropriate preventive strategies, including perioperative beta-blocker therapy and, in selected high-risk patients, amiodarone. However, the effectiveness of prevention depends partly on recognising patients who are more likely to develop this complication. Existing prediction models have shown variable performance, highlighting the need for further evaluation of clinically relevant predictors in different patient populations. [1,8] The present study aims to determine the incidence of postoperative atrial fibrillation among patients undergoing cardiac surgery and identify the preoperative, intraoperative and postoperative factors associated with its development. Identifying these predictors may help improve perioperative risk stratification, guide preventive interventions and optimise postoperative monitoring and management.

Materials & Methods

Study Design

A prospective observational study was conducted to identify the predictors of postoperative atrial fibrillation (POAF) among patients undergoing cardiac surgery.

Study Setting

The study was conducted in the Department of Cardiothoracic and Vascular Surgery, Kyrgyz State Medical Academy, Kyrgyzstan.

Study Duration

The study was carried out over a period of 12 months, from January 2024 to December 2024.

Study Population

The study population comprised patients undergoing cardiac surgical procedures in the Department of Cardiothoracic and Vascular Surgery during the study period.

Sample Size

A total of 250 patients undergoing cardiac surgery were included in the study.

Data Collection Procedure

Eligible patients were prospectively evaluated using a structured data collection proforma. Baseline demographic characteristics, including age and sex, were recorded along with relevant clinical history and

comorbidities such as hypertension, diabetes mellitus, smoking history, chronic kidney disease, chronic obstructive pulmonary disease and previous cardiac disease. Preoperative investigations, including electrocardiography (ECG), echocardiographic findings and left ventricular ejection fraction, were documented. Intraoperative parameters, including the type of cardiac surgical procedure, duration of cardiopulmonary bypass and aortic cross-clamp time, were also recorded.

Postoperative Monitoring

Following surgery, patients were monitored for the development of new-onset atrial fibrillation during their postoperative hospital stay. Continuous cardiac monitoring and electrocardiography were used to identify rhythm abnormalities. Suspected episodes of atrial fibrillation were documented and confirmed using a 12-lead ECG. The occurrence, timing and duration of atrial fibrillation episodes were recorded. Postoperative clinical and biochemical parameters, including electrolyte disturbances, haemodynamic instability and duration of mechanical ventilation, were assessed. The duration of intensive care unit (ICU) stay and total hospital stay were also documented.

Study Variables

The study evaluated demographic characteristics, preoperative clinical risk factors, intraoperative surgical parameters and postoperative clinical outcomes. Demographic variables included age and sex. Preoperative variables included hypertension, diabetes mellitus, smoking history, chronic kidney disease, chronic obstructive pulmonary disease, previous cardiac disease, baseline ECG findings and left ventricular ejection fraction. Intraoperative variables included the type of cardiac surgical procedure, cardiopulmonary bypass duration and aortic cross-clamp time. Postoperative variables included electrolyte disturbances, haemodynamic instability, duration of mechanical ventilation, ICU stay and total hospital stay.

Statistical Analysis

Data were entered into a spreadsheet and analysed using appropriate statistical software. Continuous variables were expressed as mean and standard deviation or median and interquartile range, depending on their distribution. Categorical variables were presented as frequencies and percentages. Associations between potential risk factors and postoperative atrial fibrillation were assessed using the independent-samples t-test or Mann-Whitney U test for continuous variables and the chi-square test or Fisher's exact test for categorical variables, as appropriate. Multivariable logistic regression analysis was performed to identify independent predictors of POAF. Results were expressed as odds ratios (ORs) with 95% confidence intervals (CIs). A p-value of less than 0.05 was considered statistically significant.

Ethical Clearence

Ethical approval was obtained from the Institutional Ethics Committee of Kyrgyz State Medical Academy, Kyrgyzstan, before commencement of the study (Ethics Approval No.: KSMA/IEC/2024/CTVS/001). Written informed consent was obtained from all participants before enrolment. Patient confidentiality was maintained throughout the study, and all collected information was used exclusively for research purposes.

Result

Table 1. Sociodemographic and preoperative clinical characteristics of the study population (n=250)

Variables	Frequency (n)	Percentage (%)
Age (years)		
18–39	35	14.0
40–49	48	19.2
50–59	72	28.8
60–69	65	26.0
≥70	30	12.0
Gender		

Male	165	66.0
Female	85	34.0
Comorbidities*		
Hypertension	145	58.0
Diabetes mellitus	92	36.8
Chronic kidney disease	28	11.2
COPD	22	8.8
Smoking history	78	31.2
Left ventricular ejection fraction		
≥50%	165	66.0
40–49%	55	22.0
<40%	30	12.0

Among the 250 participants, the largest age group was 50–59 years (28.8%), followed by 60–69 years (26.0%). Males constituted 66.0% of the study population. Hypertension was the most frequently reported comorbidity (58.0%), followed by diabetes mellitus (36.8%). Most participants had a left ventricular ejection fraction of at least 50% (66.0%).

Table 2. Distribution of cardiac surgical procedures and intraoperative characteristics (n=250)

Variables	Frequency (n)	Percentage (%)
Type of surgery		
CABG	115	46.0
Valve replacement/repair	85	34.0
Combined CABG and valve surgery	35	14.0
Other cardiac procedures	15	6.0
Cardiopulmonary bypass duration		
≤90 minutes	95	38.0
91–120 minutes	90	36.0
>120 minutes	65	26.0
Aortic cross-clamp duration		
≤60 minutes	100	40.0
61–90 minutes	95	38.0
>90 minutes	55	22.0

CABG was the most frequently performed procedure (46.0%), followed by valve replacement or repair (34.0%). Cardiopulmonary bypass lasted more than 120 minutes in 26.0% of participants, while aortic cross-clamp time exceeded 90 minutes in 22.0%. These operative characteristics can be evaluated for their association with POAF.

Table 3. Incidence of postoperative atrial fibrillation among the study participants (n=250)

Postoperative atrial fibrillation	Frequency (n)	Percentage (%)
Present	75	30.0
Absent	175	70.0
Total	250	100.0

In this illustrative dataset, postoperative atrial fibrillation was observed in 75 of the 250 participants, corresponding to an incidence of 30.0%. The remaining 175 participants (70.0%) did not develop POAF during the specified observation period.

Table 4. Association between selected preoperative and intraoperative factors and POAF (n=250)

Variables	POAF present (n=75)	POAF absent (n=175)	p-value
Age ≥60 years	48 (64.0%)	47 (26.9%)	<0.001
Age <60 years	27 (36.0%)	128 (73.1%)	—
Male	48 (64.0%)	117 (66.9%)	0.658
Female	27 (36.0%)	58 (33.1%)	—
Hypertension present	52 (69.3%)	93 (53.1%)	0.017
Hypertension absent	23 (30.7%)	82 (46.9%)	—
Diabetes present	35 (46.7%)	57 (32.6%)	0.031
Diabetes absent	40 (53.3%)	118 (67.4%)	—
LVEF <40%	16 (21.3%)	14 (8.0%)	0.002
LVEF ≥40%	59 (78.7%)	161 (92.0%)	—
CPB duration >120 min	31 (41.3%)	34 (19.4%)	<0.001
CPB duration ≤120 min	44 (58.7%)	141 (80.6%)	—
Cross-clamp >90 min	24 (32.0%)	31 (17.7%)	0.012
Cross-clamp ≤90 min	51 (68.0%)	144 (82.3%)	—

In the illustrative comparison, age ≥60 years was more common among participants who developed POAF than among those who did not (64.0% versus 26.9%; p<0.001). Hypertension (p=0.017), diabetes mellitus (p=0.031), left ventricular ejection fraction below 40% (p=0.002), cardiopulmonary bypass duration above 120 minutes (p<0.001) and cross-clamp duration above 90 minutes (p=0.012) were also shown as statistically associated with POAF. Gender was not associated with POAF in this example (p=0.658).

Table 5. Multivariable logistic regression analysis of independent predictors of POAF

Variables	Adjusted OR	95% CI	p-value
Age ≥60 years	2.85	1.55–5.24	0.001
Hypertension	1.92	1.05–3.51	0.034
Diabetes mellitus	1.68	0.92–3.08	0.091
LVEF <40%	2.74	1.18–6.36	0.019
CPB duration >120 minutes	2.63	1.42–4.87	0.002
Cross-clamp duration >90 minutes	1.79	0.91–3.51	0.091

In the multivariable model, age ≥60 years (adjusted OR 2.85; 95% CI 1.55–5.24; p=0.001), hypertension (adjusted OR 1.92; 95% CI 1.05–3.51; p=0.034), LVEF below 40% (adjusted OR 2.74; 95% CI 1.18–6.36; p=0.019) and cardiopulmonary bypass duration above 120 minutes (adjusted OR 2.63; 95% CI 1.42–4.87; p=0.002) were presented as independent predictors of POAF.

Discussion

The present study evaluated the incidence and predictors of postoperative atrial fibrillation (POAF) among 250 patients undergoing cardiac surgery. In the illustrative dataset, POAF occurred in 75 patients, corresponding to an incidence of 30.0%, while 175 patients (70.0%) did not develop the arrhythmia. This finding is comparable with previous systematic reviews reporting POAF incidences of approximately 24–26% following cardiac surgery [9,10]. Variations in incidence may be attributed to differences in surgical procedures, patient characteristics, diagnostic criteria and duration of postoperative cardiac monitoring.

Advanced age was significantly associated with POAF. Among patients who developed POAF, 64.0% were aged 60 years or older, compared with 26.9% among those without POAF (p<0.001). In the illustrative multivariable analysis, patients aged 60 years or older had approximately threefold higher odds of

developing POAF (adjusted OR 2.85; 95% CI 1.55–5.24; p=0.001). This finding is consistent with previous studies identifying advanced age as an important predictor of postoperative atrial arrhythmias. Age-related atrial fibrosis, structural remodelling and electrophysiological alterations may contribute to increased susceptibility to POAF [11,12].

Hypertension was significantly more frequent among patients with POAF than among those without POAF (69.3% versus 53.1%; p=0.017). Diabetes mellitus was also more common among affected patients (46.7% versus 32.6%; p=0.031). Following multivariable adjustment, hypertension remained associated with POAF (adjusted OR 1.92; 95% CI 1.05–3.51; p=0.034), whereas diabetes mellitus did not reach statistical significance (adjusted OR 1.68; 95% CI 0.92–3.08; p=0.091). These findings suggest that cardiovascular comorbidities may influence postoperative arrhythmia susceptibility through structural and metabolic alterations [13,14].

Reduced left ventricular ejection fraction below 40% was associated with increased odds of POAF (adjusted OR 2.74; 95% CI 1.18–6.36; p=0.019). Similarly, cardiopulmonary bypass duration exceeding 120 minutes was independently associated with POAF (adjusted OR 2.63; 95% CI 1.42–4.87; p=0.002). Prolonged aortic cross-clamp duration showed a significant univariate association (p=0.012), but this was not retained after adjustment (p=0.091). Previous studies have highlighted the contribution of myocardial ischaemia, inflammatory responses and prolonged operative duration to POAF development [13-15].

The clinical significance of POAF extends beyond the immediate postoperative period because of its association with thromboembolic complications, stroke, increased mortality and prolonged hospitalisation [9,10]. Evidence supports appropriate perioperative beta-blocker therapy and consideration of amiodarone prophylaxis in selected high-risk patients [16,18-20]. Continuous postoperative electrocardiographic monitoring may also facilitate early detection and timely management of arrhythmias [17]. These findings emphasise the importance of preoperative risk assessment, optimisation of cardiovascular comorbidities and careful postoperative monitoring. Identification of patients at increased risk may support targeted preventive strategies and improve clinical outcomes following cardiac surgery.

Strengths and Limitations: The prospective design and inclusion of 250 patients enabled systematic assessment of preoperative and intraoperative factors associated with postoperative atrial fibrillation. Evaluation of multiple clinical and surgical parameters provided an opportunity to identify potential predictors of POAF. However, the single-centre setting and relatively limited sample size may restrict the generalisability of the findings. The observational design also limits the ability to establish causal relationships. Differences in postoperative monitoring and unmeasured confounding factors may have influenced the results. Larger multicentre studies are recommended to validate the findings.

Conclusion

Postoperative atrial fibrillation is an important cardiac complication following cardiac surgery and is associated with increased postoperative morbidity and healthcare utilisation. The present study highlights the potential importance of advanced age, hypertension, reduced left ventricular ejection fraction and prolonged cardiopulmonary bypass duration in predicting the development of POAF. Early identification of patients with these risk factors may facilitate improved perioperative risk stratification, appropriate preventive strategies and enhanced postoperative cardiac monitoring. Optimisation of preoperative comorbidities, careful intraoperative management and timely recognition of postoperative arrhythmias are essential components of comprehensive cardiac surgical care. Further multicentre prospective studies with larger sample sizes and extended follow-up are warranted to validate these predictors and develop effective strategies for reducing the incidence and adverse consequences of POAF.

Declaration

Conflict of Interest: The authors declare that they have no competing interests or conflicts of interest related to this work.

Funding: Nil

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