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Effect of Intravenous Amiodarone Versus Propranolol on Heart-Rate Control and Prevention of Postoperative Atrial Fibrillation in Patients Undergoing Coronary Artery Bypass Grafting

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Abstract

Background: Coronary artery disease (CAD) is the leading cause of cardiovascular mortality worldwide. This randomized controlled trial compared intravenous amiodarone and intravenous propranolol for heart-rate control and prevention of postoperative atrial fibrillation (AF) in patients undergoing isolated coronary artery bypass grafting (CABG).

Methods: Sixty adults with CAD undergoing CABG were randomized into two groups. Group A (n=30) received intravenous amiodarone (3 mg/kg) before aortic declamping, while Group B (n=30) received intravenous propranolol (1 mg, repeated as needed up to three doses). Baseline demographic, clinical, preoperative, and intraoperative characteristics were comparable between groups.

Results: Amiodarone was associated with significantly better early postoperative outcomes than propranolol. Thirty-day mortality was lower in the amiodarone group (0% vs. 13.3%, P=0.031), with fewer cases of renal dysfunction (0% vs. 13.3%, P=0.031), severe postoperative bleeding >1000 mL (3.3% vs. 23.3%, P=0.022), and cardiac complications (3.3% vs. 26.7%, P=0.026). Patients receiving amiodarone also had a shorter time to extubation (34.4 ± 10.0 vs. 39.6 ± 8.4 hours, P=0.033). However, the incidence of postoperative AF at 3 days, 1 week, and 4 weeks was similar between the groups (all P>0.05). Within the amiodarone group, postoperative AF was associated with prolonged ICU stay (P=0.03) and total hospital stay (P=0.001). Univariable analysis identified increased left atrial (LA) diameter and reduced left ventricular ejection fraction (LVEF) as significant predictors of postoperative AF. Multivariable analysis demonstrated that an LA diameter >45 mm was the only independent predictor (P=0.007), while reduced LVEF showed a borderline association (P=0.079).

Conclusions: Amiodarone and propranolol demonstrated comparable efficacy in preventing postoperative AF after isolated CABG. However, amiodarone was associated with superior early postoperative outcomes, including lower mortality, reduced renal dysfunction, shorter extubation time, and fewer bleeding and cardiac complications. An LA diameter >45 mm independently predicted postoperative AF, which was associated with longer ICU and hospital stays.

KEYWORDS
Amiodarone; Propranolol; Inderal; Atrial Fibrillation; Coronary Artery Bypass Graft; Coronary Artery Disease; Beta-Blocker

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Introduction

Coronary artery disease (CAD) remains the most prevalent cardiovascular condition and the leading cause of mortality worldwide [1]. Coronary artery bypass grafting (CABG) is a fundamental therapeutic intervention for severe CAD; however, postoperative cardiovascular events and cardiac arrhythmias continue to pose significant challenges in these patients [2]. Among these complications, atrial fibrillation (AF) is the most frequent arrhythmia following cardiac surgery. Affecting approximately one-third of CABG patients, postoperative AF presents with diverse clinical manifestations, multifactorial etiologies, and complex management requirements [3].

The diagnosis of AF relies on clinical indicators, such as an irregular pulse, hypotension, and tachycardia, confirmed by electrocardiographic (ECG) evaluation and 24-hour Holter monitoring. The optimal management of AF typically follows a systematic, three-stage approach: identifying and addressing the underlying etiology, controlling the arrhythmia while mitigating thromboembolic risk, and ultimately restoring normal sinus rhythm [4].

Beta-adrenergic antagonists (β-blockers) attenuate the severity of myocardial injury during ischemia and reperfusion through negative inotropic and chronotropic actions, stabilization of cell membranes, attenuation of sympathetic tone, and a reduction in myocardial oxygen demand [5]. Perioperative β-blocker therapy may reduce the incidence of cardiovascular complications, including myocardial ischemia, stroke, and heart failure, by counteracting tachycardia and catecholamine-induced hypertension [6].

Amiodarone is a class III antiarrhythmic agent with multichannel activity that is widely utilized in the management of supraventricular and ventricular arrhythmias, particularly those associated with acute myocardial infarction. The perioperative administration of amiodarone, whether intravenously or orally for 3 to 5 days before and after CABG, has been shown to reduce the incidence of postoperative AF [4].

Accordingly, this study aimed to compare the efficacy of amiodarone with propranolol (Inderal, a β-blocker) in achieving optimal heart-rate control and in preventing postoperative AF in patients undergoing CABG.

Patients and Methods

Study Design and Setting

This randomized controlled trial was conducted at Benha University Hospital between 2025 and 2026, involving 60 adult patients with CAD scheduled for isolated CABG. The study protocol was approved by the Research Ethics Committee of Benha University, and written informed consent was obtained from all participating patients prior to enrollment.

Eligibility Criteria

Inclusion criteria comprised male and female patients aged 35 to 70 years scheduled for isolated CABG with a left ventricular ejection fraction (LVEF) greater than 50%. Patients were excluded if they required concomitant procedures (such as valve replacement); had hemodynamic instability, acute heart failure, acute coronary syndrome, multiorgan failure, or other acute disorders; or were undergoing redo open-heart surgery or emergency CABG. Patients with a known history of arrhythmia other than transient sinus tachycardia were also excluded.

Preoperative Assessment

A comprehensive preoperative evaluation was performed for all participants, including a detailed medical history and physical examination (general, cardiovascular, respiratory, abdominal, and extremity assessments). Preoperative cardiac investigations included a 12-lead ECG to confirm baseline sinus rhythm, as well as echocardiography to evaluate left ventricular function, ejection fraction, regional wall-motion abnormalities, and valvular competence.

Randomization and Interventions

Patients were randomly assigned to one of two treatment arms:

Group A (n = 30): Received an intravenous infusion of amiodarone (3 mg/kg diluted in 100 mL

Table 1: Distribution of demographic and comorbidity data between the studied populations. Data presented as mean ± SD or frequency (%)

Variables	Amiodarone group (n = 30)	β-blocker group (n = 30)	P value
Demographic data			
Age (years)	48.6 ± 8.5	50.3 ± 7.73	0.441
Gender			
Male	18 (60%)	16 (53.3%)	0.602
Female	12 (40%)	14 (46.7%)	0.602
Comorbidities			
Hypertension	24 (80%)	24 (80%)	>0.99
Diabetes mellitus	11 (36.7%)	12 (40%)	0.791
Hypercholesterolemia	27 (90%)	28 (93.3%)	0.640
Smoker habits	25 (83.3%)	26 (86.7%)	0.718
CVD	2 (6.7%)	2 (6.7%)	>0.99
PVD	1 (3.3%)	2 (6.7%)	0.554

CVD: cardiovascular disease; PVD: peripheral vascular disease.

of normal saline) administered over 10 minutes prior to aortic declamping [7].

Group B (n = 30): Received intravenous propranolol (Inderal) at a dose of 1 mg over 1 minute. The dose was repeated every 2 minutes as necessary, up to a maximum of three doses.

Surgical Procedure

Following the induction of general anesthesia and endotracheal intubation, patients were equipped with invasive monitoring lines, a central venous catheter, and where indicated a pulmonary artery catheter and a transesophageal echocardiography transducer. A median sternotomy was performed to harvest the left internal mammary artery (LIMA), while the saphenous vein was simultaneously harvested using either an open or video-assisted technique. Systemic heparinization was administered prior to central aortic and venous cannulation for cardiopulmonary bypass (CPB). Cardiac arrest was induced using high-potassium cardioplegia. Following completion of distal coronary anastomoses, the conduits were anastomosed to the proximal aortic ostia. After cardioplegia washout and resumption of cardiac activity, graft patency and hemostasis were meticulously verified. The chest was then closed using sternal wires, and the patient was transferred to the intensive care unit (ICU) [8].

Outcome Measures

Continuous monitoring of vital signs, hemodynamics, and ECG was maintained throughout the ICU stay. The initial cardiac rhythm was recorded within 30 minutes following aortic declamping and monitored until the restoration of stable sinus rhythm. A 24-hour Holter ECG was performed at three distinct postoperative time points to evaluate heart-rate variability (HRV) and to detect the occurrence of postoperative AF.

The primary outcome was the comparative efficacy of amiodarone and propranolol (Inderal) in achieving optimal rate control, as measured by postoperative heart rate and HRV. Secondary outcomes included the incidence of postoperative AF, hemodynamic stability (assessed via blood pressure and the requirement for vasoactive medications), the duration of ICU and total hospital stay, and the occurrence of adverse events associated with the study medications, such as bradycardia, hypotension, and other arrhythmias.

Statistical analysis

Statistical analyses were conducted using IBM SPSS Statistics, version 28. Quantitative variables were expressed as mean ± standard deviation (SD) and compared using the independent Student's t-test. Categorical variables were reported as frequencies and percentages, and group comparisons were performed using the Chi-square test or Fisher's exact test, as appropriate. Univariable logistic regression was used to identify

Table 2: Distribution of preoperative and operative data, and details of coronary artery disease, between the studied groups. Data presented as mean ± SD or frequency (%)

Variables	Amiodarone group (n = 30)	β-blocker group (n = 30)	P value
Preoperative			
PTCA	25 (83.3%)	23 (76.7%)	0.519
IABP	3 (10%)	3 (10%)	>0.99
Unstable angina	11 (36.7%)	10 (33.3%)	0.787
LA diameter (cm)	4.1 ± 0.6	3.8 ± 0.9	0.134
LVEF (%)	57.1 ± 4.1	58.3 ± 3.4	0.234
Operative — Vessel disease			
Single	3 (10%)	7 (23.3%)	0.165
Multiple	27 (90%)	23 (76.7%)	
Operative — Number of grafts			
1	5 (16.7%)	5 (16.7%)	0.847
2	4 (13.3%)	5 (16.7%)	
3	11 (36.7%)	13 (43.3%)	
4	10 (33.3%)	7 (23.3%)	
LIMA usage	24 (80%)	23 (76.7%)	0.754
Details of CAD			
Left main disease	10 (33.3%)	9 (30%)	0.781
Three-vessel disease	9 (30%)	11 (36.7%)	0.584
Two-vessel disease	9 (30%)	10 (33.3%)	0.781
Complete revascularization	30 (100%)	30 (100%)	>0.99

PTCA: percutaneous transluminal coronary angioplasty; IABP: intra-aortic balloon pump; LA: left atrium; LVEF: left ventricular ejection fraction; LIMA: left internal mammary artery

factors associated with postoperative AF. Variables demonstrating a P-value < 0.1 in the univariable analysis were subsequently incorporated into a multivariable logistic-regression model to determine independent predictors. Results were reported as odds ratios (OR) with corresponding 95% confidence intervals (CI). A P-value < 0.05 was considered statistically significant.

Results

Baseline Characteristics and Operative Data

No statistically significant differences were observed between the two groups concerning baseline demographic characteristics or the prevalence of preoperative comorbidities (P > 0.05) (Table 1). Both groups were also comparable regarding preoperative status, the extent of CAD, and intraoperative variables, with no statistically significant differences identified across these parameters (Table 2).

Postoperative Outcomes

Analysis of early postoperative outcomes revealed statistically significant differences between the groups, all favoring the amiodarone arm. Compared with propranolol, amiodarone was associated with lower 30-day hospital mortality (0% vs 13.3%, P = 0.031), less renal dysfunction defined as serum creatinine > 1.4 mg/dL (0% vs 13.3%, P = 0.031), shorter time to extubation (34.4 ± 10.0 vs 39.6 ± 8.4 h, P = 0.033), and a lower incidence of severe postoperative bleeding > 1000 mL (3.3% vs 23.3%, P = 0.022). No significant differences were observed for early mortality at 48 hours, duration of inotropic support, low cardiac output syndrome, postoperative heart-rate distribution, the need for hemodialysis, or postoperative LVEF (Table 3).

Postoperative Complications and Atrial Fibrillation

The amiodarone group also experienced fewer cardiac complications compared with the propranolol group (3.3% vs 26.7%, P = 0.026). No significant differences were observed in pulmonary, neurological, gastrointestinal, or

Table 3: Distribution of postoperative data between the studied populations. Data presented as mean ± SD or frequency (%)

Variables	Amiodarone group (n = 30)	β-blocker group (n = 30)	P value
Hospital mortality (within 30 d)	0 (0%)	4 (13.3%)	0.031*
Early mortality (48 h)	0 (0%)	0 (0%)	>0.99
Duration of inotropic support (d), mean ± SD Median (min–max)	4.6 ± 2.19 4.3 (2–9.4)	5.1 ± 1.63 5 (2–7.5)	0.331
LCOS	1 (3.3%)	1 (3.3%)	>0.99
Postoperative pulse rates (bpm)			
> 75	10 (33.3%)	9 (30%)	0.990
65–75	8 (26.7%)	9 (30%)	0.990
55–65	7 (23.3%)	7 (23.3%)	0.990
45–55	5 (16.7%)	5 (16.7%)	0.990
Renal dysfunction (Cr > 1.4 mg/dL)	0 (0%)	4 (13.3%)	0.031*
Hemodialysis	0 (0%)	0 (0%)	>0.99
Time to extubation (h)	34.4 ± 10.0	39.6 ± 8.4	0.033*
Postoperative bleeding > 1000 mL	1 (3.3%)	7 (23.3%)	0.022*
LVEF (%)	55.03 ± 16.2	55.5 ± 12.0	0.898

PTCA: percutaneous transluminal coronary angioplasty; IABP: intra-aortic balloon pump; LA: left atrium; LVEF: left ventricular ejection fraction; LIMA: left internal mammary artery

infectious complications between the two groups. The incidence of postoperative AF at 3 days (20% vs 23.3%), 1 week (16.7% vs 20%), and 4 weeks (13.3% vs 16.7%) did not differ significantly between the two groups (all P > 0.05) (Table 4).

Impact of Postoperative Atrial Fibrillation

Within the amiodarone cohort, the development of postoperative AF was associated with a significantly prolonged length of stay in both the intensive care unit (P = 0.03) and the hospital overall (P = 0.001) (Table 5).

Predictors of Postoperative Atrial Fibrillation

Univariable logistic-regression analysis demonstrated that an increased left atrial diameter and a reduced left ventricular ejection fraction were significantly associated with the occurrence of postoperative AF (P = 0.002 and P = 0.011, respectively). All other variables evaluated in the univariable analysis did not reach statistical significance (P > 0.05). Subsequent multivariable analysis identified a left atrial diameter > 45 mm (OR 53.561, 95% CI 2.900–989.071, P = 0.007) as an independent predictor of postoperative AF; reduced LVEF showed a trend toward significance without reaching the predefined threshold (OR 0.689, 95% CI 0.456–1.043, P = 0.079) (Table 6).

Table 4: Distribution of postoperative complications and atrial fibrillation between the studied populations. Data presented as frequency (%)

Variables	Amiodarone group (n = 30)	β-blocker group (n = 30)	P value
Complications			
Pulmonary	1 (3.3%)	1 (3.3%)	>0.99
Neurological	1 (3.3%)	2 (6.7%)	>0.99
Gastrointestinal	1 (3.3%)	2 (6.7%)	>0.99
Cardiac	1 (3.3%)	8 (26.7%)	0.026
Infectious	1 (3.3%)	3 (10%)	0.612
Atrial fibrillation			
AF, first 3 d	6 (20%)	7 (23.3%)	0.754
AF, 1 week	5 (16.7%)	6 (20%)	0.739
AF, 4 weeks	4 (13.3%)	5 (16.7%)	0.718

AF: atrial fibrillation

Table 5: Effect of atrial fibrillation defined at the 4-week postoperative assessment on length of stay within the amiodarone group. Data presented as mean ± SD

Variables	AF group (n = 4)	No-AF group (n = 26)	P value
ICU stay (days)	3.5 ± 0.57	1.85 ± 1.40	0.03
Total hospital stay (days)	13.3 ± 1.7	7.09 ± 2.7	0.001

Discussion

Atrial fibrillation (AF) is one of the most frequently encountered arrhythmias following CABG and represents a significant postoperative complication that can adversely affect patient recovery and clinical outcomes. Consequently, pharmacological prophylaxis forms a critical component of perioperative management. Beta-blockers and antiarrhythmic medications, such as amiodarone, are among the most frequently employed prophylactic agents, as both have demonstrated efficacy in reducing the incidence of postoperative atrial arrhythmias [9].

In the current study, no statistically significant differences were observed between the two cohorts regarding preoperative clinical characteristics, including the presence of unstable angina, prior percutaneous transluminal coronary angioplasty (PTCA), use of an intra-aortic balloon pump (IABP), left atrial (LA) diameter, and LVEF. These baseline similarities align with the findings of El-Nahas et al. [9], who investigated 100 patients developing postoperative AF after CABG. In their study, patients were equally allocated to receive either amiodarone or nebivolol (a β-blocker), and the authors reported no substantial difference between the cohorts regarding ejection fraction.

The present study also identified no statistically significant differences between the populations concerning the extent of CAD, such as left main coronary artery disease, or two- and three-vessel disease, the number of grafts performed, or the utilization of the LIMA. Complete revascularization was achieved in all cases across both groups. Supporting these observations, Kojuri et al. [10] similarly found that the extent of CAD did not differ significantly between patients treated with propranolol versus those treated with amiodarone.

Table 6: Univariable and multivariable logistic-regression analyses for risk factors associated with postoperative atrial fibrillation

Variable	Univariate OR	Univariate P	Univariate 95% CI	Multivariate OR	Multivariate P	Multivariate 95% CI
Age	1.034	0.455	0.948–1.128	—	—	—
Gender	0.321	0.182	0.061–1.699	—	—	—
Hypertension	2.200	0.479	0.248–19.527	—	—	—
Diabetes mellitus	0.775	0.738	0.174–3.458	—	—	—
Hypercholesterolemia	NE	0.999	NE	—	—	—
Smoker habits	1.488	0.725	0.163–13.589	—	—	—
CVD	2.000	0.569	0.184–21.691	—	—	—
PVD	NE	0.999	NE	—	—	—
PTCA	2.200	0.479	0.248–19.527	—	—	—
IABP	NE	0.999	NE	—	—	—
Unstable angina	0.481	0.391	0.091–2.558	—	—	—
LA diameter (cm)	44.720	0.002*	3.862–517.786	53.561	0.007*	2.900–989.071
LVEF (%)	0.752	0.011*	0.604–0.937	0.689	0.079	0.456–1.043

A P value < 0.05 is considered statistically significant (*). Variables with a P value < 0.1 in the univariable analysis were entered into the multivariable model. NE: not estimable due to quasi-complete separation (zero cell). CVD: cardiovascular disease; PVD: peripheral vascular disease; PTCA: percutaneous transluminal coronary angioplasty; IABP: intra-aortic balloon pump; LA: left atrium; LVEF: left ventricular ejection fraction; OR: odds ratio; CI: confidence interval

Regarding postoperative outcomes, the present study demonstrated that amiodarone was associated with significantly more favorable results than propranolol across several measures. Specifically, 30-day hospital mortality, the incidence of renal dysfunction, time to extubation, and the rate of severe postoperative bleeding (> 1000 mL) were all significantly lower in the amiodarone group. Cardiac complications were likewise less frequent in the amiodarone group. These findings differ from those of El-Nahas et al. [9], who reported no significant differences in postoperative morbidity or mortality between their amiodarone and β-blocker groups. The discrepancy may reflect differences in the specific β-blocker used (nebivolol vs propranolol), dosing regimens, and patient characteristics.

Crucially, the incidence of postoperative AF did not differ significantly between the two cohorts when evaluated at three days, one week, or four weeks postoperatively. This finding is corroborated by Ardaya et al. [11], who reviewed randomized controlled trials comparing amiodarone and β-blockers for the prevention of AF following CABG and concluded that there was no significant difference in the number of AF episodes between the two treatment strategies. Conversely, Solomon et al. [12] reported a postoperative AF incidence of 16.0% in patients receiving amiodarone compared with 32.7% in those receiving β-blockers ($P = 0.05$). This discrepancy with the current study may be attributable to differences in the specific amiodarone dosing regimens employed.

Within the amiodarone cohort, patients who developed postoperative AF experienced significantly prolonged stays in both the ICU and the hospital compared with those who maintained sinus rhythm. This observation is consistent with the findings of Lin et al. [13], who demonstrated that the development of AF during critical illness is strongly correlated with a prolonged duration of hospitalization.

Finally, univariable regression analysis in the current study indicated that an increased LA diameter and a reduced LVEF were significantly associated with the development of postoperative AF. Subsequent multivariable analysis confirmed that an LA diameter > 45 mm was an independent predictor of postoperative AF following CABG, whereas reduced LVEF showed only a non-significant trend in the adjusted model. These results are in agreement with previously published evidence identifying preoperative LA dilatation as a substantial and independent predictor of postoperative AF across cardiac and thoracic surgical populations [14].

Limitations

The present study has several limitations that warrant consideration. First, the investigation was constrained by a relatively small sample size and a single-center design, which may limit the generalizability of the findings. Second, the short follow-up period of up to four weeks restricts the ability to assess late postoperative outcomes and the long-term recurrence of arrhythmias. Third, the wide confidence intervals observed for several univariable estimates reflect limited statistical power for some comparisons. The OR estimate for LA diameter should be interpreted with caution given this instability.

Conclusion

Amiodarone and propranolol demonstrate comparable efficacy in preventing postoperative AF following isolated CABG. However, amiodarone is associated with more favorable early postoperative outcomes, including lower 30-day mortality, less renal dysfunction, shorter time to extubation, less severe bleeding, and fewer cardiac complications. An enlarged left atrial diameter (> 45 mm) is an independent predictor of postoperative AF, a complication that significantly prolongs both ICU and total hospital length of stay.

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