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Incidence and Predictors of Postoperative Atrial Fibrillation after Coronary Artery Bypass Grafting Surgery

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ABSTRACT

Objective: To study the incidence of postoperative atrial fibrillation (POAF) and its predictors after coronary artery bypass grafting (CABG) in an Asian cohort.

Study Design: Cross sectional study.

Place and Duration of Study: The study was conducted at the department of Cardiothoracic Surgery, Almana Hospital, Al Khobar, Saudi Arabia, which is a tertiary care hospital. The study duration was form Oct 2019 to Dec 2021.

Methodology: All the male and female consecutive patients with coronary artery disease undergoing coronary artery bypass grafting (CABG) were included in the study. All the surgeries were performed through median sternotomy using cardiopulmonary bypass. Patients with emergency CABG, off pump CABG and those undergoing multiple procedures were excluded from the study. A total of 220 consecutive patients were included in the study. Patients were followed in the perioperative period. Various variables were recorded on a preformed proforma. Patients were divided into two groups, those who had atrial fibrillation (AF) and those who did not have AF. Data was analyzed using SPPS version 23.

Results: The mean age of the patients was 51.50±11 years in the AF group and 49.38±9 years in the no AF group. The incidence of atrial fibrillation postoperatively in our cohort was (n=52, 25%). There was no statistically significant difference between the groups with respect to hypertension and diabetes (p=0.408 and p=0.054) respectively).

Conclusion: In spite of a younger population, the incidence of AF in our cohort undergoing CABG is comparable to the international literature. Lack of preoperative β-blockers, statins and low ejection fraction are predictors of new onset POAF.

Keywords: Atrial fibrillation, Coronary artery bypass grafting, Incidence, New onset.

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INTRODUCTION

The leading cause of death in the developed world is ischemic heart disease. It is also the most common form of heart disease.[1] The gold standard for treatment of ischemic heart disease is coronary artery bypass grafting (CABG). Coronary artery bypass grafting is performed in suitable patients with coronary artery disease with comparative and sometimes superior outcomes.[2] One of the postoperative complications of CABG is atrial fibrillation and if not diagnosed and treated on time, it leads to further complications like hemodynamic deterioration, stroke and increased mortality in these already compromised patients. Patient experiencing even a single episode of atrial fibrillation in the immediate postoperative period have worse long-term outcome compared to those who did not have atrial fibrillation.[3] Therefore, it is essential to employ effective prophylactic protocols against new onset POAF as it reduces hospitalization and overall morbidity.

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It is observed that the demographics and risk profile of the patients undergoing coronary artery surgery in Asian population is different because of a different epidemiological pattern of ischemic heart disease. This study sheds light on the incidence of new onset atrial fibrillation after coronary artery bypass grafting in our population cohort and gives a glimpse of the patient characteristics.

METHODOLOGY

New onset postoperative atrial fibrillation was defined as atrial fibrillation in the immediate postoperative period in a patient who was in sinus rhythm preoperatively. Important definitions were as follows.

- Obesity: Obesity was defined as BMI> 35kg/m^2
- Lack of Preoperative use of Hydrocortisone: When patients did not receive at least 200 mg of hydrocortisone at the time of induction of anesthesia.
- Lack of preoperative use of Statins: When any type of statin was not given in the two weeks period before the surgery.

- Lack of Preoperative beta blocker use: When any type of cardio-selective β-blocker was not used in the preceding two weeks before surgery.
- History of atrial fibrillation: Patients who already had atrial fibrillation in the past but in sinus rhythm before the surgery and not on any anti-AF medication.

A cross sectional descriptive study was conducted at the department of cardiothoracic surgery, Almana Hospital, Al Khobar, Saudi Arabia from October 2019 to December 2021.

Sample Size: Sample size was calculated by using 17% prevalence which was found to be 217 but we recrited to 220 patients to increase the strength of study.[4]

Inclusion Criteria: All the male and female consecutive patients who had double, triple or left main coronary artery disease, undergoing coronary artery bypass grafting (CABG)were included in the study. All the surgeries were performed using cardiopulmonary bypass (CPB) through a median sternotomy.

Exclusion Criteria: Patients undergoing off pump (CABG), emergency CABG and those with multiple procedures like CABG and aortic valve replacement were excluded from the study. Moreover, patients who had previous percutaneous coronary intervention were also excluded.

All the surgeries were performed by the same team of cardiac surgeons who use essentially the same protocol for various perioperative aspects of the management. The study was approved by the ethical review board of the hospital and since no new intervention was being done, individual consent was waivered.

Post-operatively, patients were monitored in ICU. Frequency of atrial fibrillation and common factors leading to this complication were studied.

Various perioperative variables were recorded on a preformed proforma and analyzed on SPPS version 23 (SPSS, Inc., Chicago, IL). Mean±SD was calculated for quantitative variables like weight. They were compared using Student t test. Frequencies and percentages were calculated for categorical variables like atrial fibrillation. Common factors leading to atrial fibrillation were stratified among age, gender, indication for CABG, aortic cross clamp time etc. A χ^2 -test was used to compare categorical variables. After the initial analysis, variables with probability less than 0.1 were used as independent variables for a stepwise forward Wald multivariate logistic regression model to determine significant predictors of new onset postoperative atrial fibrillation. *p*-value of 0.05 or less was considered as significant.

RESULTS

A total of 220 patients were included in the study. All the patients were included in the final analysis and there was no patient lost. Mean age of the patients was 51.50±11 years in the AF group and 49.38±9 years in the no AF group. There was no statistical difference between the groups with respect to gender (*p*=0.204). The basic demographics of the patients are presented in Table-I.

Table-I: Baseline characteristics and demographics of the patients

Variables		AF n= 55	*p*-value
Gender	Male	43 (78%)	0.204
	Female	12 (22%)	
Age (years)		51.50±11	0.534
Weight (Kg)		66.85±13.08	0.075
Body surface area (kg.m-2)		1.95±0.246	0.056
Hypertension		16 (29.09%)	0.408
Diabetes		12 (21.81%)	0.054
Pre-op serum urea (mg. dl-1)		31.23±10.1	0.322
Pre-op serum creatinine (mg.dl-1)		1.32±.18	0.465
Aortic Cross Clamp time in minutes		94.8±44.32	0.324
CBP time in minutes		142.33±23.17	0.325

CPB=Cardiopulmonary bypass

Of the cohort, a significant number of patients in the AF group had triple vessel coronary artery disease (*p*=0.001). Variables significantly associated with atrial fibrillation postoperatively were obesity 17(10%) vs 24 (44.63%), *p*=0.001, lack of preoperative statins 31 (18.78% vs 40(72.32%), *p*=0.001 and lack of preoperative beta blockers (40 (24.24%) vs 39 (71%), *p*=0.003) and those with ejection fraction less than 35%, 16(10%) vs 17 (30.90%), *p*=0.003) in AF and no AF groups respectively.

There was no significant difference in both the groups with respect to hypertension and diabetes (*p*=0.408 & *p*=0.054) respectively.

Variables significantly associated with atrial fibrillation postoperatively by univariate analysis were obesity 17(10%) vs 24(45%), *p*=0.01, lack of preoperative corticosteroids 75(45.43%) vs 15(75%), *p*=0.01, lack of preoperative statins 31(49.2% vs 40(73%), *p*=0.001, lack of preoperative beta blockers 40(24%) vs 39(71%), p=0.003) and history of atrial fibrillation 19(12%) vs 33(60%), *p*=0.002 patients with no atrial fibrillation and those with atrial fibrillation respectively. Preoperative hemoglobin was weakly associated with new onset

postoperative AF (13.8±1.67 gm/dl) vs (12.17±3.5 gm/dl) p=0.04 respectively). Similarly, patient having LV ejection fraction less than 35% also showed significant association with postoperative atrial fibrillation (p=0.003). Postoperative bleeding showed a moderate association with post operative new onset AF (355±295 ml) vs (556±637 ml), p=0.001).

Intraoperative cardiopulmonary bypass time and cross clamp time were both significantly associated with AF (p=0.01 and p=0.001 respectively). Of the cohort, 36(16%) patients had left main stem significant disease and 51(23%) had double vessel disease. Both the left main and double vessel disease patients did not show significant association with atrial fibrillation (p=0.654 and p=0.634 respectively). Triple vessel disease was more common in the atrial fibrillation group with 38 out of 55 patients having triple vessel disease (p=0.001) (Table-II).

Table-II: Perioperative Variables' Association with new Onset Atrial Fibrillation After Coronary Artery Bypass Grafting

Variables		AF n=55 (25%)	*p*-value
Obesity		24(43.63%)	0.01
Lack of pre-operative hydrocortisone use		15(27.32%)	0.01
Lack of pre op statins use		40(72.73%)	0.001
Lack of pre op β-blockers use		39(71%)	0.003
Preoperative Hb (gm/dl)		12.17±3.5	0.04
History of AF		33(60%)	0.002
LV EF<35%		17(30.90%)	0.003
Smoking		12(21.81%)	0.005
Mediastinal drainage in first 24 hours (ml)		556±637	0.001
CPB time (minutes)		154±52	0.01
Cross clamp time (minutes)		106±42	0.001
Indication for CABG	LMS	8(14.54%)	0.654
	DVD	9(16.36%)	0.634
	TVD	38(69.09%)	0.001

LVEF= left ventricular ejection fraction, LMS=left main stem, DVD= Double vessel disease, TVD= Triple vessel disease

Among the variables significantly associated with new onset POAF by univariate analysis, the stepwise multivariate logistic regression model showed that lack of preoperative β-blocker use (OR=3.68), preoperative ejection fraction (OR=0.94), cross clamp time (OR=1.02), preoperative smoking (OR=1.65) and history of atrial fibrillation (OR=2.03) were independent predictors of new onset POAF (Table-III).

Table-III: Multivariate Stepwise Logistic Regression Analysis Showing Factors Independently Predicting Postoperative new Onset Atrial Fibrillation

Variable	Odd Ratio 95% CI	*p*-value
Preoperative hemoglobin	0.65, 95% CI 0.499-0.852	0.002
Lack of preoperative β-blocker use	3.68, 95% CI 1.032-13.13	0.04
Preoperative ejection fraction	0.94, 95% CI 0.88-0.98	0.019
Cross clamp time	1.02, 95% CI 1.003-1.035	0.024
Preoperative smoking	1.65, 95% CI 1.02-1.771	0.001
History of atrial fibrillation	2.03,95% CI 1.55-2.66	0.001
Mediastinal drainage in first 24 hours	2.23, 95% CI 1.97-2.86	0.001

DISCUSSION

Numerous advances have been made in recent years in the care of patients undergoing CABG including more refined protocols for cardioplegic arrest and surgical techniques. But despite these advances, the incidence of postoperative atrial fibrillation has paradoxically increased in recent years as a result of the increasing age of patients undergoing surgery and worse risk profile in terms of comorbidities.

Atrial fibrillation complicates the postoperative course in 15-30% of the patients.[4] In our study, the frequency of post-operative atrial fibrillation was 25.0%.

Age has consistently been found to be a predictor of post operative AF in the literature. But this was insignificant in our study. This can be attributed to the fact that the overall cohort was young, in both the group.[5]

An important finding in our study was the significant association between mediastinal drainage and atrial fibrillation postoperative. It also proved to be an independent predictor of new onset POAF. This phenomenon has been studied in the literature and the possible mechanism can be attributed to the oxidation and inflammation triggered by the lysing retained clots in the pericardium.[6] For this reason, active clearance mechanism for shed mediastinal blood has been linked to reduced incidence of POAF.[7]

Severity of coronary artery disease has been demonstrated as an independent predictor of new onset postoperative AF. Ducceschi *et al* has reported the association of post CABG atrial fibrillation with the severity of coronary artery disease.[8] This is consistent with our study which showed that patient with triple vessel disease were more prone to AF postoperatively. Involvement of right coronary artery in these patients may be a reason as shown by Al- Shanafey *et al* who have described that diseased Sino Atrial (SA) artery

(branch of right coronary artery) is significantly associated with AF post-CABG.[9] Although our study has not specifically investigated it, nonetheless, it is evident that patients with triple vessel disease had more involvement of the right coronary artery than those with single or double vessel disease.

Our study showed a higher incidence of post-operative AF in obese patients. Obesity predisposes the patient to respiratory complications and prolonged ventilation. Both these factors have been shown to be risk factors for AF after CABG.[10] Patients with high BMI undergoing cardiac surgeryare more prone to other comorbid factors like Type-II diabetesmellitus, hypertensionand hyperlipidemia. Thus, the overall risk profile of these patients is comparatively high which renders them at risk of AF.[11]

Inflammation has been shown to play an important role in the pathogenesis of atrial fibrillation after cardiac surgery. Corticosteroids are known to have a potent anti-inflammatory effect and their use in the prevention of post-operative AF has been explored. In a largemeta-analysis by Lu Liu *et al.* involving more than thirteen thousand patients, it was concluded that corticosteroid therapy was associated with a significant reduction in new onset post-operative AF and also shorter hospital stay.[12] Our study showed a higher incidence of postoperative AF in patients who were not given preoperativecorticosteroids. The use of steroids may have an adverse effect on glucose metabolism, wound healing, and postoperativeinfection. In a randomized control trial, Al-Shawabkeh and colleagues demonstrated the safety and efficacy of short-term corticosteroid use in reducing new onset atrial fibrillation after CABG.[13] In a large patient level systematic review and meta-analysis, Dvirnik and colleagues suggested caution in the prophylactic use of corticosteroids for postoperative AF as the major trails included in the study did not show any benefit.[14] These studies indicate the role of corticosteroids for prophylaxis of AF is controversial and needs further studies.

Preoperative statins are shown to reduce the incidence of AF in our study. Statins have anti-inflammatory and anti-oxidant action apart from preventing atherosclerosis. These qualities may be protective against atrial fibrillation. The anti-inflammatory effect of statins may be due to its pleiotropic properties leading to decreased markers of inflammation like white cell count.[15] Statins not only reduce the incidence of new onset AF after CABG, but also significantly reduces the hospital length of stay and this effect has been found to be more pronounced in patients undergoing CABG compared to those valvular or hybrid surgeries.[16,17]

Preoperative use of β-blockers helps in controlling not only the heart rate but also the sympathetic output. This effect may be protective against AF as evident from decrease incidence of post-operative AF in patients who were taking β-blockers preoperatively in our study. Kim *et al*. observed in a meta-analysis of 25,496 patients that the risk of POAF was significantly less in patients who received preoperative beta-clockers.[18]

Our study provides an insight to the risk profile of patients undergoing CABG. It shows that our patients are younger but with an extensive pattern of coronary artery disease. Moreover, most of the risk factors for AF described in international literature are also found in our cohort.

LIMITATIONS OF STUDY

This study certainly has limitations like a comparatively smaller number of patients, a descriptive design and only in-hospital outcomes have been presented.

CONCLUSION

Postoperative AF is the most common arrhythmia after CABG. As cardiac surgeons are operating patients with higher risk profile due to advancements in percutaneous interventions, the incidence is expected to increase even further. The incidence of postoperative atrial fibrillation in our cohort is compatible with international literature but with obvious difference in the demographic profile of our patients. Large scale studies are needed to elaborate this further.

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Conflict of Interest: None.

Author's Contribution

Following authors have made substantial contributions to the manuscript as under:

MS: Intellectual contribution, concept and final approval

IK: Manuscript writing, concept and editing

FEF: Intellectual, contribution, study design, referencing

SMHK: Final approval, Intellectual contribution, concept

MEH: Manuscript writing, editing, finalizing article

W: Data collection, data management, analysis

ZMK: Intellectual contribution, critical review, editing

RJ: Result interpretation, study design, referencing

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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