Postoperative Atrial Fibrillation in Coronary Artery Bypass Grafting Herald Poor Outcome

Pulkit Malhotra, Shantanu Pande, Supaksh Mahindru, Ankit Thukral, Ankush Singh Kotwal, Rajan Prasad Gupta, Prabhat Tewari, Surendra Kumar Agarwal

Departments of Cardiovascular and Thoracic Surgery and Anaesthesiology, Sanjay Gandhi Postgraduate Institute of Medical Sciences, Lucknow, Uttar Pradesh, India

ABSTRACT

**Introduction:** Atrial fibrillation in postoperative period is common. Although the event of atrial fibrillation is associated with reduced cardiac output and its consequences and cerebrovascular events, its effect on outcome is not clearly documented. This study is done to evaluate the effect of atrial fibrillation on outcome of the operation.

**Materials and Methods:** This is a retrospective case-control study. A total of 263 patients received coronary artery bypass grafting during this period. The data for demographics, comorbidities, preoperative medications, operative details, and echocardiographic parameters of left ventricular functions were acquired. A total of 24 patients had atrial fibrillation (Group I), while 239 remained in normal sinus rhythm (Group II). The outcome is measured as combined of death and postoperative myocardial infarction (MI).

**Results:** The groups are comparable in demographic, preoperative medications, operative, and left ventricular parameters. Of the 24 (9.12%) patients who had postoperative atrial fibrillation, 11 were discharged on medical management. Nine patients reverted to sinus rhythm at discharge. Atrial fibrillation persisted in 8 patients 1 week after discharge and 3 patients after 1 month. The requirement of intraaortic balloon pump (IABP) was statistically significant in group I (5 in group I vs. 10 in group II, \( n = 0.001 \)). There were 4 deaths in group 1 and 7 in group 2 (\( P = 0.002 \)), however, the combined end point was achieved in 4 (16.6%) vs. 22 (9.2%), respectively, \( P = 0.1 \).

**Conclusion:** The appearance of atrial fibrillation heralds increased requirement of IABP, MI, and death in patients undergoing coronary artery bypass grafting.

**Keywords:** Atrial Fibrillation, outcome after postoperative atrial fibrillation, postoperative coronary artery bypass grafting

INTRODUCTION

Atrial fibrillation following cardiac surgery is an important factor affecting mortality in early postoperative care.\(^1\) Though not common in preoperative period, its occurrence after coronary artery bypass grafting varies between 20% and 50% in various studies.\(^2,3\) Indian data is scanty on this issue; however, a study quoted an incidence of 8% in postoperative period.\(^4\) Atrial fibrillation leads to reduction in cardiac output and puts the patient at the risk of embolic cerebrovascular event.\(^5\) The incidence of atrial fibrillation increases with age and is observed increasingly common in patients with structural heart disease.\(^6\) The incidence of atrial fibrillation is more among patient of valvular heart disease.\(^7\) Framingham heart study has observed poor outcome in atrial fibrillation patients at long-term.

Access this article online

| Quick Response Code: |
|----------------------|
| Website: www.annals.in |
| DOI: 10.4103/aca.ACA_30_20 |

How to cite this article: Malhotra P, Pande S, Mahindru S, Thukral A, Kotwal AS, Gupta RP, et al. Postoperative atrial fibrillation in coronary artery bypass grafting herald poor outcome. Ann Card Anaesth 2021;24:464-9.
especially in uncontrolled heart rate.\textsuperscript{[7]} However, if the atrial fibrillation is controlled using available energy devices, the quality of life improves.\textsuperscript{[8]} With this background knowledge and not an uncommon occurrence of atrial fibrillation following coronary artery bypass grafting (CABG), its effect on the immediate outcome is not clearly documented. In this study, we plan to observe the incidence of the postoperative occurrence of atrial fibrillation after CABG and its possible effect on the outcome of this sinister condition.

**MATERIALS AND METHODS**

This study includes patients operated between January 2018 and April 2019. This is a retrospective case-control study. This study is approved by the institute ethics committee. During this period, a total of 263 patients underwent CABG. All these patients were enrolled in this study. Patients reporting atrial fibrillation after CABG were included in group 1 ($n = 24$) and those who remained in normal sinus rhythm were designated group 2 ($n = 239$). All the patients were operated using off-pump coronary artery bypass grafting technique.\textsuperscript{[9]} They received total arterial revascularization using both internal mammary arteries.

Inclusion criteria include patients undergoing isolated coronary artery bypass grafting, age above 20 years, and normal sinus rhythm. Exclusion criteria include patients undergoing concomitant valve surgery, atrial fibrillation, acute myocardial infarction (MI), unstable angina, urgent surgery, or use of cardiopulmonary bypass to perform CABG.

The data is collected using hospital information services and patients’ case records from a archive. The immediate, at discharge, and one-month follow-up paper 12 lead ECG is used to diagnose and record atrial fibrillation. Echocardiography of preoperative and one-month postoperative period is recorded for left ventricular size, function, and status of mitral valve competence. Intensive care unit data is accessed for collection of information like 24 h blood drainage output, transfusion of blood and blood products, requirement of intraaortic balloon pump (IABP), collection of investigation data, etc.

Primary endpoint of the study is mortality, perioperative MI, and combined end point of both of them. The secondary endpoint is the use of IABP. Universal definition of MI based on creatinine kinase (CK MB) in post CABG patient is used for diagnosis.\textsuperscript{[10]} IABP was inserted when the patients presented with low cardiac output with the requirement of adrenaline dose of more than 0.05 µg/kg/min. Low cardiac output was diagnosed clinically. Patients developing atrial fibrillation during operation were reverted to normal sinus rhythm with electric cardioversion using internal paddles. Development of atrial fibrillation in intensive care unit was treated with injection amiodarone with loading of 300 mg in 30 min followed by continuous infusion to achieve a total dose of 1 g. The patients were then discharged on oral medication of 200 mg once daily for a period of 6 weeks.

Power of study is calculated by the prevalence of the atrial fibrillation in this study (9.12%) and the difference in the combined endpoint achieved in each group (25% in group 1 vs. 11.2% in group 2, $P = 0.10$). To achieve a power of 80%, the study must have 127 patients of postoperative atrial fibrillation (group 1) and similar number of propensity-matched patients in group 2. Hence, this study fails to achieve the required power of 80%. The power of study for patients in this study is calculated post hoc on the basis of combined end point is 39.7% and for mortality is 74.9%.

**Statistics**

Two groups are unequal in numbers; hence, a non-parametric test is chosen to compare two groups. Mann–Whitney U test is applied. The variables are expressed as median and minimum and maximum values. Pearson's correlation is done between variables whenever required. Chi-square test is used to compare two nominal variables. SPSS version 17 for windows (SPSS, Inc. Chicago, IL, USA) is used for statistical analysis.

**RESULTS**

Patients in both the groups have similar demographics. Similarly, the risk factors that may trigger atrial fibrillation are not significantly different. Echocardiographic parameters defining left ventricular size and function are also not different in two groups [Table 1]. There was no correlation between the occurrence of atrial fibrillation and left ventricular ejection fraction, serum potassium, serum creatinine, ventilation time, and duration of operation. However, total blood loss postoperatively was positively correlated to occurrence of atrial fibrillation ($r = 0.19$, $P = 0.001$). All relevant intraoperative and postoperative factors are similar in two groups [Table 2]. The outcomes in the study are mentioned in Table 3. Overall mortality in the study is 4.18% with 16.6% in group 1 and 2.9% in group 2. However, there was no perioperative MI in group 1. The use of IABP was significantly higher in group 1. Intraoperative atrial fibrillation was witnessed in 11 patients and all were reverted back to normal sinus rhythm using DC shock before shifting the patient back.
to intensive care unit. Atrial fibrillation occurring in postoperative period was treated medically with infusion of amiodarone \( (n = 24) \). All patients had control of heart rate with many reverting to sinus rhythm. At discharge, 11 patients of a total of 24 remained in atrial fibrillation. At 1 week, 8 remained in atrial fibrillation and at 1 month, it reduced to 3 patients who remained in atrial fibrillation.

Follow-up echocardiography was available at 1 month for all the discharged patients. Left ventricular end-systolic dimension is 28 mm (23–45) in group 1 vs. 28 mm (25–48) in group 2, \( P = 0.63 \). The left ventricular end-diastolic dimension is 46 mm (22–55) in group 1 vs. 45 mm (20–65) in group 2, \( P = 0.55 \). Left ventricular ejection fraction is 45% (32–50) in group 1 and 45% (26–60) in group 2, \( P = 0.96 \). The left atrial size is 32 mm (28–53) in group 1 vs. 32 mm (26–50) in group 2, \( P = 0.47 \). During clinical follow-up of 6 months, all the patients are alive.

**DISCUSSION**

This study has a small number of patients who experience atrial fibrillation after coronary artery bypass grafting \( (n = 24, 9.12\%) \). Intraoperative atrial fibrillation was witnessed in 11 patients and was reverted using DC shock during the procedure. All the patients reverted to normal sinus rhythm before shifting to intensive care unit. At the time of discharge, 11 patients remained in atrial fibrillation though with controlled heart rate and 3 patients continued to be in atrial fibrillation at 1 month. There are not many studies that follow the patient of atrial fibrillation as to what happens to their rhythm.\(^\text{[11]}\) In past, the occurrence of atrial fibrillation was considered benign and self-limiting, but it has been proven beyond doubt that such postoperative events increase mortality.\(^\text{[12,13]}\) The sinister effect of atrial fibrillation is due to loss of the atrial kick and subsequent loss of cardiac output.\(^\text{[14]}\) The incidence in our study is very low as compared to the lone Indian study by Dave et al., considering the patients’ characteristics are similar.\(^\text{[1]}\) This difference may be due to the use of off-pump technique as compared to on cardiopulmonary bypass as in Dave et al. study. One reason is inflammatory response which is mostly similar in two techniques but few pathways are more pronounced with use of cardiopulmonary bypass.\(^\text{[15]}\) Moreover, Bohatch et al. have shown increased incidence of atrial fibrillation when cardiopulmonary bypass is used to perform surgical revascularization.\(^\text{[10]}\) Our patients did not require endarterectomy, which is associated with higher occurrence of atrial fibrillation in early postoperative period.\(^\text{[17]}\)

Inflammation is an important factor that triggers atrial fibrillation after an operation. Weymann et al. in their study on inflammation have supported that C reactive protein is an important factor in causation of atrial fibrillation.\(^\text{[18]}\) Though we did not study the inflammatory parameters, lactate dehydrogenase levels were higher in patients experiencing atrial fibrillation in this study. Inflammatory response has been suppressed by higher dose of statins.\(^\text{[19]}\) This may be one of the reasons that patients in this study experienced a lower incidence of atrial fibrillation. In our study, more than 70% of patients were receiving beta-blockers at the time of surgery; hence, the incidence of atrial fibrillation may have been lower as suggested by many studies.\(^\text{[20,21]}\)

Few studies have shown a reduction of atrial fibrillation with beta-blocker prophylaxis to 7%–8% in postoperative

**Table 1: Risk factors and preoperative variables**

| Variable              | Group 1 \( n=24 \) | Group 2 \( n=239 \) | \( P \) |
|-----------------------|--------------------|---------------------|-------|
| Age in years          | 59.5 (40-70)       | 59 (23-81)          | 0.58  |
| Male (\( n \))        | 19                 | 189                 | 0.54  |
| Female (\( n \))      | 5                  | 50                  | 0.04  |
| BMI                   | 23.4 (17.4-31.6)   | 24.8 (17.6-40.7)    | 0.34  |
| NYHA Class            |                    |                     | 0.12  |
| 1                     | 2                  | 7                   |       |
| 2                     | 12                 | 135                 |       |
| 3                     | 10                 | 97                  |       |
| Diabetes Mellitus (%) | 8 (33.3)           | 91 (38.1)           | 0.80  |
| Hypertension (%)      | 10 (41.7)          | 104 (43.5)          | 0.94  |
| Tobacco Consumption (%)| 6 (25%)            | 52 (21.8)           | 0.59  |
| Preoperative \( \beta \) blocker (%) | 19 (79.2) | 221 (92.5) | 0.57  |
| Preoperative statin (%) | 17 (70.8)       | 179 (74.9)          | 0.82  |
| LDH (IU/l)            | 280 (120-963)      | 179 (29-707)        | 0.04  |
| LVEDD in mm           | 26 (20-40)         | 28 (24-50)          | 0.35  |
| LVEDD in mm           | 46 (36-86)         | 46 (23-63)          | 0.31  |
| LVEF (%)              | 50 (25-60)         | 55 (20-60)          | 0.07  |
| LVEF <35%             | 3                  | 21                  | 0.67  |
| LA size in mm         | 38.1 (30-50)       | 32 (28-50)          | 0.69  |
| RVSP in mm Hg         | 46 (33-68)         | 37 (22-53)          | 0.21  |

NYHA: New York Heart Association, LDH: Lactate dehydrogenase level, LVEDD: Left Ventricular End-Systolic Dimension, LVEDD: Left Ventricular End-Diastolic Dimension, LVEF: Left Ventricular Ejection Fraction, LA: Left Atrium, RVSP: Right Ventricular Systolic Pressure

**Table 2: Operative and intensive care data**

| Variable              | Group 1 \( n=24 \) | Group 2 \( n=239 \) | \( P \) |
|-----------------------|--------------------|---------------------|-------|
| Number of grafts      | 3 (1-4)            | 3 (1-5)             | 0.78  |
| Blood transfusion (\( n \)) | 1.5 (0-6) | 1 (0-10)            | 0.13  |
| Blood drain 24 h (ml) | 935 (150-1570)     | 880 (164-1460)      | 0.58  |
| Hypertension (%)      | 14.5 (13-41)       | 16 (5-648)          | 0.98  |
| ICU stay (h)          | 72 (52-96)         | 56 (50-62)          | 0.15  |

ICU: Intensive Care Unit

**Table 3: Outcome variable**

| Variable              | Group 1 \( n=24 \) | Group 2 \( n=239 \) | \( P \) |
|-----------------------|--------------------|---------------------|-------|
| POMI (\( n \))        | 0                  | 15                  | 0.26  |
| Mortality (\( n \))   | 4                  | 7                   | 0.002 |
| Combined end point (\( n \)) | 4             | 22                  | 0.10  |
| IABP (\( n \))        | 5                  | 10                  | 0.001 |

POMI: Perioperative Myocardial Infarction, IABP: Intraaortic Balloon Pump
period in patients undergoing coronary artery bypass grafting, which is the case in our study.\textsuperscript{[23]} Similarly, a retrospective analysis from a large sample of patients from a surgical database reported a reduction in postoperative mortality from 3.4\% to 2.8\% with the use of preoperative beta-blockers.\textsuperscript{[23]} The benefit in prevention of postoperative atrial fibrillation was achieved by prophylactic usage of either of the class drugs, metoprolol, carvedilol, timolol, or atenolol.\textsuperscript{[24‑27]} Halonen et al. reported a further improvement in reducing the postoperative atrial fibrillation if metoprolol was used intravenously as compared to oral route.\textsuperscript{[28]} Although a study by Maniar et al. could not report any advantage with intravenous esmolol over oral usage of metoprolol, they reported a concern of higher incidence of hemodynamic compromise with the use of esmolol.\textsuperscript{[29]} A study has reported better results in controlling postoperative atrial fibrillation with carvedilol when its prophylactic use was compared to metoprolol.\textsuperscript{[30]} Prophylactic use of amiodarone has also shown to reduce postoperative atrial fibrillation significantly.\textsuperscript{[31]} However, a trial failed to replicate these results when the control group was already receiving beta-blockers, calcium channel blockers, or digoxin.\textsuperscript{[32]} A large meta-analysis by Bagshaw et al. suggested that prophylactic use of amiodarone is effective in reducing the incidence of postoperative atrial fibrillation in patient undergoing cardiac surgery.\textsuperscript{[33]} However, both metoprolol and amiodarone were found to be equally effective in controlling postoperative atrial fibrillation when they were administered prophylactically.\textsuperscript{[34]}

Patients in our study were also different as compared to western studies. The major differences that could have affected the appearance of atrial fibrillation are lack of obesity and younger age at the time of procedure. Obesity can be one of the trigger factors for the appearance of atrial fibrillation as suggested by Wang et al.\textsuperscript{[35]} It is also suggested that increased oxidative stress and or lipoapoptosis increases the chances of atrial fibrillation by causing structural changes in atria.\textsuperscript{[36,37]} Increased size of left atrium is also one of the contributing factors for atrial fibrillation that is missing in our study patients.\textsuperscript{[38]} Age is relatively younger than western studies; the incidence of coronary artery disease in younger patients is witnessed in India.\textsuperscript{[39]} Old age remains the strongest risk factor for onset of atrial fibrillation. Mathew et al. suggested that increase in age in excess of 70 years increases the incidence of atrial fibrillation.\textsuperscript{[40]}

Our study also highlighted a higher mortality rate in patients who developed atrial fibrillation. Similar facts have been validated by other studies, with even higher rate of mortality even after 1 and 3 years of follow-up.\textsuperscript{[41]} Villareal et al. also witness an increased incidence of mortality in their series associated with atrial fibrillation after coronary artery bypass grafting.\textsuperscript{[42]} Though other studies also report an increased early mortality rate,\textsuperscript{[43,44]} this was not observed in studies done by Kalavrouziotis et al. and Rubin et al.\textsuperscript{[12,45]} However, a large study with a 5-year follow-up recently reported that risk-adjusted outcome at 5 years was similar after coronary artery bypass grafting independent of appearance of atrial fibrillation.\textsuperscript{[46]}

Limitation of the study
This study has a small number of patients experiencing new onset atrial fibrillation after coronary artery bypass grafting. This may give us a trend but reliability of the data can only be achieved with an appropriate power of study. A larger study and possibly a multicenter study are required to effectively cover all the aspects of atrial fibrillation after coronary artery bypass grafting.

CONCLUSION
This study reports a lower incidence (9.12\%) of atrial fibrillation after coronary artery bypass grafting. However, in patients who develop atrial fibrillation, there was a significantly higher incidence of application of IABP in postoperative period. The mortality rates were also significantly higher in this group of patients.

Ethical approval statement
Ethical approval was waived by the local Ethics Committee of the institute in view of the retrospective nature of the study and all the procedures being performed were part of the routine care.

Financial support and sponsorship
Nil.

Conflicts of interest
There are no conflicts of interest.

REFERENCES
1. Conen D, Alonso-Coello P, Douketis J, Chan MTV, Kurz A, Sigamani A, et al. Risk of stroke and other adverse outcomes in patients with perioperative atrial fibrillation 1 year after non-cardiac surgery. Eur Heart J Eur Heart J 2020;41:645‑51.
2. Cox JL. A perspective of postoperative atrial fibrillation in cardiac operations. Ann Thorac Surg 1993;56:405‑9.
3. Kaw R, Hernandez AV, Masood I, Gillinov AM, Saliba W, Blackstone EH. Short- and long-term mortality associated with new-onset atrial fibrillation after coronary artery bypass grafting: A systematic review and meta-analysis. J Thorac Cardiovasc Surg 2011;141:1305‑12.
4. Dave S, Ningude A, Gujar P, Sharma R. Incidence and risk factors for development of atrial fibrillation after cardiac surgery under cardiopulmonary bypass. Indian J Anaesth 2018;62:887‑91.
5. Hogue CW Jr, Murphy SF, Schechtman KB, Davila-Roman VG. Risk

Annals of Cardiac Anaesthesia | Volume 24 | Issue 4 | October-December 2021
467
Malhotra, et al.: Outcome following postoperative atrial fibrillation

factors for early or delayed stroke after cardiac surgery. Circulation 1999;100:642-7.

6. Gumprecht J, Domek M, Lip GYH, Shantsila A. Invited review: Hypertension and atrial fibrillation: Epidemiology, pathophysiology, and implications for management. J Hum Hypertens 2019;33:824-36.

7. Schnabel RB, Yin X, Gona P, Larson MG, Beiser AS, MacManus DD, et al. 50 year trends in atrial fibrillation prevalence, incidence, risk factors, and mortality in the Framingham heart study: A cohort study. Lancet 2015;386:154-62.

8. Driessen AHG, Berger WR, Bierhuizen MFA, Piersma FR, van den Berg NEW, Neefs J, et al. Quality of life improves after thoracoscopic surgical ablation of advanced atrial fibrillation: Results of the Atrial fibrillation ablation and autonomic modulation via thoracoscopic surgery (AFACT) study. J Thorac Cardiovasc Surg 2018;155:972-80.

9. Pande S, Agarwal SK, Kundu A, Kale N, Chaudhary A, Dhir U. Off-pump coronary artery bypass in severe left ventricular dysfunction. Asian Cardiovasc Thorac Ann 2009;17:54-8.

10. Kelley-Cote EP, Lamy A, Devreux PJ, Kavak P, Lamontagne F, Cook DJ, et al. Definitions of post-coronary artery bypass grafting myocardial infarction: Variations in incidence and prognostic significance. Eur J Cardiothorac Surg 2020;57:168-75.

11. Landmore RW, Howell F. Recurrent atrial arrhythmias following treatment for postoperative atrial fibrillation after coronary bypass operations. Eur J Cardiothorac Surg 1991;5:436-9.

12. Rubin DA, Nieminski KE, Reed GE, Herman MV. Predictors, prevention, and long-term prognosis of atrial fibrillation after coronary bypass graft operations. J Thorac Cardiovasc Surg 1987;94:331-5.

13. Almassi GH, Schwalter T, Nicolosi AC, Aggarwal A, Moritz TE, Henderson WG, et al. Atrial fibrillation after cardiac surgery: A major morbidity event? Ann Surg 1997;226:501-13.

14. Omer S, Cornwall LD, Bakshi A, Rachlin E, Prezenta O, Rosengart TK, et al. Incidence, predictors, and impact of postoperative atrial fibrillation after coronary artery bypass grafting in military veterans. Tex Heart Inst J 2016;43:397-403.

15. Antoniades C, Demosthenous M, Reilly S, Margaritis M, Zhang MH, Antonopoulus A, et al. Myocardial redox state predicts in-hospital clinical outcome after cardiac surgery effects of short-term pre-operative statin treatment. J Am Coll Cardiol 2012;59:60-70.

16. Bohacht Júnior MS, Matkovski PD, Di Giovanni FJ, Fenni R, Varella EL, Dietrich A. Incidence of postoperative atrial fibrillation in patients undergoing on-pump and off-pump coronary artery bypass grafting. Rev Bras Cir Cardiovasc 2015;30:316-24.

17. Marzban M, Karimi A, Ahmadi H, Davoodi S, Abbasii K, Movahedi N, et al. Early outcomes of double-vessel coronary endarterectomy in comparison with single-vessel coronary endarterectomy. Tex Heart Inst J 2008;35:119-24.

18. Weymann A, Popoy AF, Sahashinikav A, Ali-Hassan-Saegh S, Ryazanov M, Tse J, et al. Baseline and postoperative levels of C-reactive protein and interleukins as inflammatory predictors of atrial fibrillation following cardiac surgery: A systematic review and meta-analysis. Kardiol Pol 2018;76:440-51.

19. Pierri MD, Crescenzi G, Zingaro C, D’Alfonso, Capestro F, Socco V, et al. Prevention of atrial fibrillation and inflammatory response after on-pump coronary artery bypass using different statin dosages: A randomized, controlled trial. Gen Thorac Cardiovasc Surg 2016;64:395-402.

20. Eschli M, Badkoubeh RS, Mousavi M, Radmehr H, Salehi M, Tavakoli N, et al. Oral ascorbic acid in combination with beta-blockers is more effective than beta-blockers alone in the prevention of atrial fibrillation after coronary artery bypass grafting. Tex Heart Inst J 2007;34:268-74.

21. Xiaosan W, Congxia W, Jinyun Z, Chunyan Z, Yan Z, Yanhua G. Meta-analysis of randomized controlled trials on magnesium in addition to beta-blocker for prevention of postoperative atrial arrhythmias after coronary artery bypass grafting. BMC Cardiovasc Disord 2013;13:5.

22. Andrews TC, Reimold SC, Berlin JA, Antman EM. Prevention of supraventricular arrhythmias after coronary artery bypass surgery. A metaanalysis of randomised control trials. Circulation 1991;84:III236-44.

23. Ferguson TB Jr, Coombs LP, Peterson ED. Society of Thoracic Surgeons National Adult Cardiac Surgery Database. Pre-operative B-blocker use and mortality and morbidity following CABG surgery in North America. J Am Med Assoc 2002;287:2221-7.

24. Lucio EA, Flores A, Blacher C, Leyes PE, Lucchese FA, Ribeiro JP. Effectiveness of metoprolol in preventing atrial fibrillation and flutter in the postoperative period of coronary artery bypass graft surgery. Arq Bras Cardiol 2003;82:42-6.

25. Tsuboi J, Kawazoe K, Izumoto H, Okabayashi H. Postoperative treatment with carvedilol, a-Adrenergic blocker, prevents paroxysmal atrial fibrillation after coronary artery bypass grafting. Circ J 2008;72:588-91.

26. White HD, Antman EM, Glynn MA, Collins JJ, Cohn LH, Shemin RL, et al. Efficacy and safety of timolol for prevention of supraventricular tachyarrhythmia after coronary artery bypass surgery. Circulation 1984;70:749-84.

27. Lamb RK, Prabhakar G, Thorpe JAC, Smith S, Norton R, Dyde JA. The use of atenolol in the prevention of supraventricular arrhythmias following coronary artery surgery. Eur Heart J 1989;9:32-6.

28. Halonen J, Hakala T, Aivynen T, Karjalainen J, Turpeinen A, Uusaro A, et al. Intravenous administration of metoprolol is more effective than oral administration in the prevention of atrial fibrillation after cardiac surgery. Circulation 2006;114:14-4.

29. Maniar PB, Harris NB, Tamis JE, Steinberg JS. Intravenous versus oral beta-blocker for prevention of post-CABG atrial fibrillation in high risk patients identified by signal averaged ECG: Lessons of pilot study. Card Electrophysiol Rev 2003;7:158-61.

30. Aickel S, Bozbas H, Gultekin B, Aydinlap S, Saritas B, Bal U, et al. Comparison of efficacy of metoprolol and carvedilol for preventing atrial fibrillation after coronary bypass surgery. Int J Cardiol 2008;126:108-13.

31. Mitchell LB, Exner DV, Wyse DG, Mitchell LB, Exner DV, Wyse DG, et al. Prophylactic oral amiodarone for the prevention of arrhythmias that begin early after revascularization, valve replacement, or repair. PAPABEAR: A randomized controlled trial. JAMA 2005;294:3093-3100.

32. Redle JD, Khurana S, Marzan R, McCullough PA, Stewart JR, Westveer DC, et al. Prophylactic oral amiodarone compared with placebo for prevention of atrial fibrillation after coronary artery bypass surgery. Am Heart J 1999;138:44-50.

33. Bagshaw SM, Galbraith PD, Mitchell LB, Sauve R, Exner DV, Ghali WA. Prophylactic amiodarone for prevention of atrial fibrillation after cardiac surgery: A meta-analysis. Ann Thorac Surg 2006;82:1927-37.

34. Tokmakoglu H, Kandemir O, Gunaydin S, Cazav Z, Organcioglu C, Zorlutuna Y. Amiodarone versus digoxin and metoprolol combination for then prevention of postcoronary bypass atrial fibrillation. Eur J Cardiothorac Surg 2002;21:401-5.

35. Wang TJ, Paris H, Levy D, D’Agostino RB Sr, Wolf PA, Vasan RS, et al. Obesity and the risk of new-onset atrial fibrillation. JAMA 2004;292:2471-7.

36. Vincent HK, Powers SK, Stewart DJ, Shanely RA, Demirel H, Naito H. Obesity is associated with increased myocardial oxidative stress. Int J Obes Relat Metab Disord 1999;23:67-74.

37. Zhou YT, Grayburn P, Karim A, Shimabukuro M, Higa M, Baetens D, et al. Incidence, predictors, and impact of obesity is associated with increased myocardial oxidative stress. Int J Obes Relat Metab Disord 1999;23:67-74.
39. Iyengar SS, Gupta R, Ravi S, Thangam S, Alexander T, Manjunath CN, et al. Premature coronary artery disease in India. Coronary artery disease in the young (CADY) registry. Indian Heart J 2017;69:211-6.

40. Mathew JP, Fontes ML, Tudor IC, Ramsay J, Duke P, Mazer CD, et al. A multicenter risk index for atrial fibrillation after cardiac surgery. JAMA 2004;291:1720-9.

41. Tsai YT, Lai CH, Loh SH, Lin CY, Lin YC, Lee CY, et al. Assessment of the risk factors and outcomes for postoperative atrial fibrillation patients undergoing isolated coronary artery bypass grafting. Acta Cardiol Sin 2015;31:436-43.

42. Villareal RP, Hariharan R, Liu BC, Kar B, Lee VV, Elayda M, et al. Postoperative atrial fibrillation and mortality after coronary artery bypass surgery. J Am Coll Cardiol 2004;43:742-8.

43. Ahlsson A, Bodin L, Fengsrud E, Englund A. Patients with postoperative atrial fibrillation have a doubled cardiovascular mortality. Scand Cardiovasc J 2009;43:330-6.

44. Mariscalco G, Engstrom KG. Postoperative atrial fibrillation is associated with late mortality after coronary surgery, but not after valvular surgery. Ann Thorac Surg 2009;88:1871-6.

45. Kalavrouziotis D, Buth KJ, Ali IS. The impact of new-onset atrial fibrillation on in-hospital mortality following cardiac surgery. Chest 2007;131:833-9.

46. Almassi GH, Hawkins RB, Bishawi M, Shroyer AL, Hattler B, Quin JA, et al. Veterans affairs Randomized on/off bypass follow-up study (ROOBY-FS) group. New-onset postoperative atrial fibrillation impact on 5-year clinical outcomes and costs. J Thorac Cardiovasc Surg 2019 Nov 14. pii: S0022-5223(19)32774-6. doi: 10.1016/j.jtcvs.2019.10.150. [Epub ahead of print]