ATRIAL FIBRILLATION FOLLOWING CORONARY ARTERY BYPASS GRAFT SURGERY

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ABSTRACT

Objective: To know the frequency of atrial fibrillation (AF) after coronary artery bypass graft surgery and the risk factors which predispose these patients to develop post-operative AF.

Material and Methods: This prospective, observational, analytic study was carried out at National Institute of Cardiovascular Diseases Karachi, from January 2001 to January 2002. It included 200 patients undergoing elective or emergency coronary artery bypass graft (CABG) surgery without concurrent valvular heart disease, prior history of AF, ventricular arrhythmias or redo CABG surgery. All patients underwent CABG and were followed for three weeks for incidence of AF. Patients who developed AF (group A) were compared with patients without AF (group B) for different variables. Univariate analysis was done using Student’s t-test for continuous variables and Chi-square test for categorical variables.

Results: The mean age was 52.78 ± 8.32 years. The average bypass time and cross clamp time were 83.20 (SD ± 18.73) minutes and 29.73 (SD ± 7.25) minutes respectively. The mean ejection fraction was 49.34%. The median number of grafts was three. The frequency of AF was 12 (6%). Univariate analysis revealed that advanced age, male sex, right coronary artery lesion, prolonged bypass time and low ejection fraction were statistically significant risk factors (p<0.005).

Conclusion: AF is a common, but potentially preventable, complication following CABG surgery. The advanced age, low ejection fraction, prolonged cross clamp and bypass time are the important risk factors which may predispose these patients to develop postoperative atrial fibrillation.

Key words: Atrial fibrillation, Coronary Artery Bypass Graft Surgery, Risk Factors.

INTRODUCTION

Atrial fibrillation (AF) after coronary artery bypass graft surgery is one of the most common and challenging complication: that is associated with increased morbidity and mortality. Patients who develop postoperative AF are more likely to have other postoperative complications such as peri-operative myocardial infarction (MI), congestive cardiac failure and respiratory failure. Postoperative atrial fibrillation is associated with longer ICU and hospital stays and consequently, the economic cost can be considerable.

The true incidence of postoperative AF following cardiac surgery is unclear; reported incidence ranges from 20-40%. The reported incidence range is wide because the studies differ in baseline patient characteristics, type of surgery, methods of detection and definitions of AF.

There is a lower incidence of AF in patients undergoing only coronary artery bypass grafting (CABG) compared to those patients undergoing valve surgery or combined CABG-valve operations. Postoperative AF most often occurs during the first five days with a peak incidence on the second and third day postoperatively.

Classically, AF is attributed to enhanced automaticity in one or several rapidly depolarizing foci and re-entry involving one or more circuits. The pathogenesis in postoperative CABG patients is not clear and is probably multifactorial. Episodes are believed to be initiated by certain triggers in patients who have an abnormal atrial substrate. Many patients have pre-existing age related degenerative changes in the atrial myocardium which serves as the abnormal substrate. High catecholamine, intraoperative hyperglycemia, reperfusion injury and
inflammation associated with cardiac surgery are thought to be involved in its pathogenesis. 8

Post-CABG atrial fibrillation is unique in that it has a high rate of spontaneous conversion. Many patients will spontaneously convert to normal sinus rhythm within the first 24 hours and more than 90% of patients will do so within 6-8 weeks of surgery. This spontaneous conversion rate is much higher than AF unrelated to open heart surgery. 9-11

Several studies have identified risk factors for developing atrial fibrillation following open heart surgery. The most frequently identified risk factors include increased age, valvular heart disease, atrial enlargement, preoperative atrial arrhythmias and chronic lung disease. 11-13

Numerous pharmacological and electrical therapies have been used to prevent atrial fibrillation, like antiarrhythmic drugs, 13 non-steroidal anti-inflammatory drugs, 14 magnesium sulphate, 15 amiodarone, 16 metoprolol, 17 short term steroids, 18 N-3 polyunsaturated fatty acid, 19 bilateral epicardial pacing, ventricular cardiac denervation 20 and preservation of epicardial fat pad 21 during CABG. The incidence of postoperative atrial fibrillation differed among the different anesthetic groups with lowest incidence in the sevoflurane group. 22

Our study objective was to identify the incidence of atrial fibrillation after coronary artery bypass graft surgery and the risk factors which may predispose these patients to develop postoperative atrial fibrillation.

MATERIAL AND METHODS

This was a prospective, observational, analytic study of 200 patients who underwent CABG Surgery, from January 2001 to January 2002, in National Institute of Cardiovascular Disease Karachi. The sample technique was that of convenience.

Two hundred consecutive patients scheduled for CABG surgery with routine cardiopulmonary bypass were studied for the prevalence of postoperative atrial fibrillation. Eligible patients were studied for the prevalence of postoperative atrial fibrillation. Eligible patients were defined as those undergoing elective or emergency CABG surgery without concurrent valvular heart disease, prior history of atrial fibrillation, ventricular arrhythmias or redo CABG surgery. After taking an informed consent, history, clinically examination and related investigations were carried out. All these patients underwent coronary artery bypass graft and were followed for three weeks for incidence of atrial fibrillation. After that they were grouped into group A, who develop atrial fibrillation and group B, who did not develop atrial fibrillation. Detail preoperative, intraoperative and postoperative data was collected, using structurally built proforma, which was completed by the single investigator at the National Institute of Cardiovascular Disease Karachi.

Operative technique: Although the operations were carried out by different surgeons but the operative technique was uniform. Cardiopulmonary bypass with moderate systemic hypothermia (28°C), moderate hemodilution (hematocrit 0.20 to 0.25) with flow rate of 2.4 l/min and mean systemic pressure of 50 to 70 mmHg was used. Bicaval venous cannulation was done in 62.5% patients while a single two-staged venous cannula was used in 37.5% of the patients. Left ventricular vent was inserted through the right superior pulmonary vein while in 25% of the patients no vent was used. Myocardial protection was achieved by intermittent aortic cross clamp with continuous fibrillatory arrest with moderate systemic hypothermia and topical cooling. Cardioplegia was not used at all. Standard surgical technique was used in all the cases performing the distal anastomosis during the period of aortic cross clamping and the proximal anastomosis by applying side biting clamp to the aorta. The left internal mammary artery and long saphenous vein grafts were used as a bypass conduits in all the patients. All the patients underwent routine intravenous and postoperative monitoring in the operation theatre and in the intensive care unit respectively. Patients were electively ventilated and kept in the intensive care unit for continuous invasive monitoring during which a 12 lead ECG was recorded on second postoperative day. Patients were shifted to the surgical ward on third postoperative day. Subsequently, the in-patients postoperative follow-up consisted of daily examination by the investigator, with a 12 lead ECG recording on sixth postoperative day, and additional ECG recording upon suspicion or sign and symptoms of arrhythmias (patient's complaint of palpitation, irregular pulse or pulse rate exceeding 100 beats/min). Finally, the patients were discharged between 7th to 9th postoperative day with a routine postoperative follow-up after two weeks in the out-patient clinic.

Statistical analysis: Data was analyzed using SPSS statistical software. Descriptive statistic i.e. frequencies, mean, median, standard deviation and 95% confidence intervals were calculated for all preoperative and postoperative variables. Univariate analysis was done using student t-test for continuous variables and Chi-square test for categoric variables. Odd ratio and 95% confidence intervals of odd ratio were also calculated for
those variables which were found statistically significant (p<0.05).

RESULTS

Atrial fibrillation developed in 12 (6%) out of 200 patients after a mean of two days (range 1-7 days) following coronary artery bypass surgery. The clinical characteristics of the patients with and without atrial fibrillation are compared in Table-1. There were no significant differences between the two groups with respect to the previous history of hypertension, diabetes mellitus, COPD, types of venous cannulations left ventricular vent, type and number of grafts, endarterectomy and the role of prophylactic beta blocker.

Step-wise logistic regression analysis of preoperative, peroperative and postoperative variables showed that advanced age was associated with a significantly greater risk of postoperative atrial fibrillation, with the mean age of 60 years in the AF group as compared to 52.28 years in non AF group (p<0.001). Similarly male gender, preoperative low ejection fraction (p=0.005), prolonged cross clamp time (p=0.005), prolonged cardiopulmonary bypass time (p=0.005) and significant right coronary artery lesion proved to be the significant predictors for post CABG atrial fibrillation.

DISCUSSION

Atrial fibrillation is one of the most common arrhythmias after coronary artery bypass graft surgery with the reported incidence up to 40% in the immediate postoperative period. Despite the frequent occurrence of atrial fibrillation after cardiac surgery, little is known about the pathogenesis of this arrhythmia. In this prospective study, risk factor analysis identified old age, low ejection fraction, right coronary artery lesion, prolonged bypass and cross-clamp time as independent and powerful predictors of atrial fibrillation after CABG surgery.

Historical predictors of postoperative atrial fibrillation include advanced aged, male sex, history of atrial fibrillation, congestive heart failure, significant right coronary artery lesion, surgical practices such as pulmonary vein vent and bicausal venous cannulation.

Advanced age increases the risk of atrial fibrillation in the general population. Therefore, it is not surprising that the incidence of the atrial fibrillation after CABG surgery also increases with age. Dilatation and fibrosis of the atria have been shown to increase with age and with a loss of side-to-side electrical coupling between groups of atrial muscle fibres. Consequently slowing of electrical conduction within the atria provides a substrate for arrhythmogenesis. In the present study the mean age in the AF group was 52.28 (SD ± 8.21) years. Our observation also favors advanced age as an important and strong predictor for the development of atrial fibrillation.

Several studies have found increased incidence of atrial fibrillation in male patients after CABG surgery, whereas other studies have reported no differences in male sex predisposition. It is probably related to the lack of sufficiently large sample of women in these studies. In our study the number of female patients was 28 comprising only 14% of the study population. However, out of 12 atrial fibrillation patients, 11(94%) patients were male. Therefore the male sex came up as an independent predictor of atrial fibrillation after CABG surgery.

It has been shown that the vulnerability for atrial fibrillation increases as the cross clamp time increases. In a study by Creswell et al the incidence of atrial fibrillation increased by 2.7% per hour of cross clamp time, while in another study they found 6% increase in the odds of
developing atrial fibrillation with each 15 minutes increase in cross clamp time. In the present study the mean cross clamp time was 29.7 (SD = 7.2) minutes and 27.33 (SD = 7.25) minutes in the AF and non-AF groups respectively. Hence in accordance with the other studies in the literature, our study also confirms prolonged cross clamp time as a predictor for atrial fibrillation.

The presence of significant right coronary artery stenosis is a powerful predictor of atrial fibrillation after coronary artery bypass graft surgery. It is suggested that intraoperative ischemia in the right coronary distribution may be important in the pathogenesis of this arrhythmias. Several investigators have reported that supraventricular arrhythmias, especially atrial fibrillation is the most frequent ECG abnormality associated with atrial infarctions, the majority of which appear to be localized to the right atrium and are frequently associated with proximal right coronary artery disease. In our study all the patients having postoperative atrial fibrillation had significant right coronary artery stenosis which strongly supports the concept of right coronary artery disease in the pathogenesis of postoperative atrial fibrillation. Only 01 out of the 12 patients, had endarterectomy done to RCA, therefore the role of endarterectomy remained non-conclusive.

The majority of prior studies have not demonstrated the relationship between the duration of cardiopulmonary bypass with the occurrence of postoperative atrial fibrillation. Only in one study a weak association of atrial fibrillation with prolonged bypass time was documented. In our study the mean bypass time was 83.5 (±7.17) minutes and 82.9 (± 19.04) minutes in the AF and non AF group respectively. Therefore we found that prolonged bypass time played an important role in the development of postoperative atrial fibrillation.

Beta blocker withdrawal with rebound hypersensitivity to catecholamines, combined with the increase in circulating catecholamines after cardiac operation, provides an attractive hypothesis for postoperative atrial fibrillation and the observed effectiveness of postoperative beta blocker therapy. Engelmann and colleagues demonstrated catecholamines release after cardiac operation but found no correlation with atrial fibrillation and no protection by prophylactic postoperative beta blocker therapy. In our study, only 11.5% patients were on beta blocker postoperatively as compared to 69% patients preoperatively on beta blocker with the beta blocker withdrawal of 52.5%. Our results do not support the concept of prophylactic beta blockers or its withdrawal as a cause of atrial fibrillation, though it is emphasized that the present study was not designed to establish drug efficacy. Our sole aim was to identify preoperative variables in risk stratification of atrial fibrillation.

Other preoperative and intraoperative variables have been mentioned in the literature including history of CCF, COPD, diabetes mellitus, hypertension, type of venous cannulation, LV vent, diuretics, number of grafts etc. were not found to have significant role in the present study population.

CONCLUSION

Atrial fibrillation is a common, but potentially preventable, complication following coronary artery bypass graft surgery. Advanced age, low ejection fraction, prolonged cross clamp and bypass time are the important risk factors which may predispose these patients to develop postoperative atrial fibrillation.

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