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ORIGINAL ARTICLES

Atrial Fibrillation following CABG Surgery. Our Experience with 100 Patients

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Abstract

Introduction: Atrial fibrillation (AF) is the most common complication of cardiac surgery, occurring in 10-40% of patients. Postoperative AF (POAF) refers to new-onset AF in a patient without a history of AF that occurs within the first four weeks after cardiac surgery. While POAF can be transient and without consequences, it may lead to severe complications, increasing mortality and morbidity in the postoperative period. Risk factors can be patient-related, intraoperative, and postoperative.

This study aimed to estimate the frequency of AF in patients after CABG combined with valvular replacement or not. Identification of patients vulnerable to arrhythmia will allow targeting of those most likely to benefit from prophylactic therapy.

Material and Methods: The presented study is a prospective study of 100 patients undergoing elective CABG from February to April 2022 with a mean age of 66 ± 13 years, 30% women, undergoing CABG at the University Hospital Centre "Mother Teresa" Tirana, that developed POAF.

Results: Postoperative atrial fibrillation occurred in sixteen patients (16%) at a median of 3.7 days after cardiac surgery (2nd – 7th day). 94% (15) of POAF occurred in CABG only, and 6% (1) in the combined intervention (AVR et CABG).

Conclusion: AF is the most common complication after CABG. The occurrence is not dependent on the type of intervention (only CABG or combined with valve replacement), the number of vessels that underwent bypass grafting, or the type of vessel. Electrolytic imbalance should be assessed during the postoperative course of patients who undergo CABG.

Keywords: Atrial Fibrillation; CABG Surgery; Cardiac Surgery.

Introduction

Coronary artery bypass grafting (CABG) is the most common heart surgery. New-onset postoperative atrial fibrillation (POAF) is the most common arrhythmia after coronary artery bypass grafting (CABG).

Although AF is often benign and transient, various factors, including prolonged length of stay, intensive care unit readmission, a greater need for reintubation, persistent congestive heart failure, stroke, and increased overall costs, have been recognized as associated with POAF.[1]

Atrial fibrillation (AF) occurs in 20% to 40% of patients after CABG. AF has been reported in up to 5-40% of patients in the early postoperative period following coronary artery bypass graft (CABG), in 37-50% after heart valve surgery, 64% undergoing mitral valve replacement plus CABG, 49% undergoing aortic valve replacement (AVR) plus CABG and in 12% after cardiac transplantation. POAF after cardiac surgery tends to occur within 2-4 days after the procedure, with a peak incidence on postoperative day 2.[2, 3, 7, 8]

Our study presents a group of 100 patients undergoing CABG with or without heart valve replacement that developed POAF and another group of 100 patients undergoing CABG with or without heart valve replacement that did not develop POAF in the early postoperative period.

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Material and Methods

The presented study is a prospective study of 100 patients undergoing elective CABG from February to April 2022 with a mean age of 66 ± 13 years, 30% women, undergoing coronary artery bypass graft surgery at the University Hospital Centre "Mother Teresa" Tirana, that developed POAF. Patients in AF or with a history of AF or receiving class I or III antiarrhythmic agents were excluded. All patients gave informed consent, and the local ethics committee approved the study.

Preoperative data included age, sex, medications, Q waves on 12-lead ECG, coronary anatomy, left ventricular ejection fraction, hemoglobin, urea, electrolytes, and magnesium concentration. Echocardiograms were performed preoperatively to assess left atrial size. Perioperative data included number of distal anastomoses, use of internal mammary artery graft, aortic cross-clamp time, cardiopulmonary bypass time, method of myocardial protection, and operator status. Postoperative data included units of blood transfused, hemoglobin, urea, electrolytes, and magnesium concentration on the two first postoperative days, duration of postoperative hospital stay, and drugs at discharge. All patients underwent CABG with or without heart valve replacement (n=100). Material for vein grafts was harvested from the saphenous vein. Internal mammary artery grafts were used in each one of them. Myocardial protection was achieved with blood cardioplegia enriched with potassium, the same used in all patients. The core temperature was allowed to decrease from 28°C to 32°C. Each patient was rewarmed to 37°C as cardiopulmonary bypass was discontinued.

Postoperatively, patients were managed in the intensive care unit (ICU) before being transferred to the ward. ECG was monitored continuously by a bedside monitor. After that, patients were examined daily, and an ECG was performed whenever AF was suspected clinically. The study endpoint was any documented episode (on 12-lead ECG) postoperative in-hospital AF, defined as an irregular rhythm with no identifiable P waves. Prophylaxis against postoperative AF was not used routinely, and the attending physician managed its occurrence.

Results

Postoperative atrial fibrillation occurred in sixteen patients (16%) at a median of 3.7 days after cardiac surgery (2nd – 7th day). 94% (15) of POAF occurred in CABG only, and 6% (1) in the combined intervention (AVR et CABG).

Atrial fibrillation was evaluated: 18.4% (9 pts / 49 CABGx3) in CABGx3, 13.0% (6 pts / 46 CABGx2) in

Variables	Total (n=100)	AF (n=16)	Non AF(n=84)
Age, y - mean	53-79	65.9	60.7
LVEF, %	50-55	50-55	50-55
Left atrial size, cm- mean	40-58	51	52
CPB time, min- mean	50-98	58	60
Clamp time, min- mean	40-66	49	50
Men, n (%)	70 (70)	11 (69)	59 (70)
Pre-op Q waves, n (%)	31 (31)	8 (50)	23 (27)
RCA stenosis, n (%)	66 (66)	8 (50)	58 (69)
Graft < 3, n (%)	46 (46)	6 (13)	40 (87)
Graft > 3, n (%)	49 (49)	9 (18.4)	40 (81.6)
Preoperative B-blocker	48 (48)	4 (25)	44 (52)
Preoperative urea >7 mmol/L, n (%)	23 (23)	3 (18.75)	20 (23.8)
Preoperative creatinine > 125 mmol/L, n (%)	18 (18)	3 (18.75)	15 (17.8)
Postoperative urea >7 mmol/L, n (%)	18 (18)	3 (18.75)	15 (17.8)
Postoperative creatinine > 125 mmol/L, n (%)	26 (26)	4 (25)	22 (26.2)
CABG + AVR, n (%)	9	1 (7.7)	8 (92.3)
CABG + MVR, n (%)	4	0 (0)	4 (100)
SPO2<92 %, n (%)	46 (46)	4 (25)	42 (50)
BMI	24.9-31	27.7	26.5
ICU/ Hospital stay, day-s	2-7/ 7-13	9.2	7.3

Table 1. Clinical characteristics of patients with and without AF after CABG

CABGx2. 7.7% (1 pts / 13 CABG et valve replacement) in combined intervention CABG and valve replacement. Patients who developed AF were older (65.9 versus 60.7 years of age; (P<0.0005) than non-AF patients. Incidence of AF increased in patients ≥75 years of age. Preoperatively, (4/16, 25%) were taking β-blockers.

AF was evaluated as equivalent (8 / 16) in patients who underwent bypass graft of RCA/PDA vessels, compared to patients who did not bypass these vessels.

Electrolyte imbalance was seen in 37.5% (6 / 16) of POAF, and a SpO2 level lower than 92% was seen in 25% (4 / 16). The hematocrit level was not significant. Thirteen (82.2%) patients developed AF at 2.8 ± 1.7 (mean; range, 0 to 11) days after the operation.

Four patients were noted to have brief (<30-s) episodes of irregular rhythm on the monitor; these episodes were not recorded on 12-lead ECG, and these patients were not included in the AF group. These patients did not develop AF during the hospital stay, and their postoperative course was unremarkable. Demographic data are presented in Table 1, and the distribution of AF is illustrated in Chart 1.2

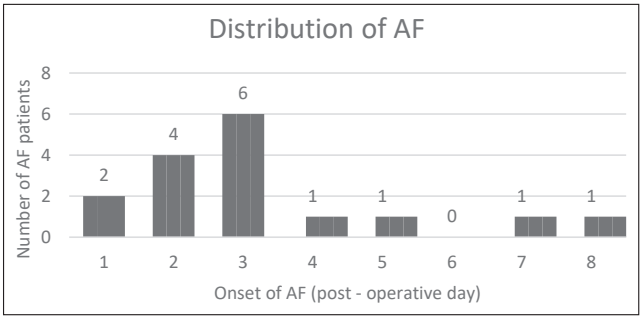

Chart 1. Distribution of AF onset.

There were no differences between AF and non-AF patients in left ventricular ejection fraction, Q waves on preoperative ECG, and left atrial diameter. Surgical techniques were similar between groups. No difference was seen between groups in preoperative or postoperative magnesium concentrations. Furthermore, no significant difference was seen between AF and non-AF groups in mean body weight (82.2 and 77.6 kg, respectively) or body mass index (27.7 and 26.5 kg/m^2, respectively). Postoperative hospital stay was significantly more extended in patients with AF than those without (9.2 versus 7.3 days; P<0.0005).

Analysis of preoperative variables identified advanced age (odds ratio, 1.53; 95% CI, 1.26 to 1.86 per 5-year increase in age; P<0.0005) and male sex (odds ratio, 2.88; 95% CI, 1.30 to 6.40; P<0.01) independently predicted AF.

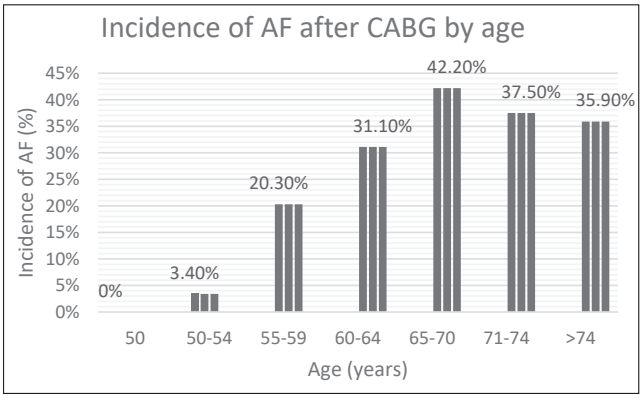

Chart 2. Incidence of AF after CABG by age.

Etiology

The etiology of AF does not indicate a specific factor, and some factors might lead to the incidence of AF. Potential factors that have been shown to play a role in the creation of atrial susceptibility to AF include pericarditis, atrial injury from surgical handling or cannulation, atrial suture lines, acute atrial enlargement from pressure or volume overload, inadequate myocardial protection during cardiopulmonary bypass, atrial ischemia, long bypass and aortic cross-clamp times, hyperadrenergic states (such as the use of postoperative inotropic medications), pulmonary complications, hypoxemia, inflammation, hypokalemia, and hypomagnesemia.[3, 4]

Prevention

According to the 2006 American College of Cardiology guidelines, the American Heart Association, and the European Society of Cardiology for the management of AF, BBs were introduced as an impressive agent to prevent postoperative AF. Based on contemporary practices, BBs can lower the risk of postoperative AF by approximately 30%, which means that despite treatment, many patients would still develop AF. Preoperative use of beta blockers in cardiac surgery patients (propranolol, carvedilol, plus *N*-acetyl cysteine) is associated with a reduced incidence of post-CABG AF by attenuating the sympathetic tone.[1, 7]

Among antiarrhythmic agents, amiodarone and sotalol are known to be more safe and efficacious in diminishing the risk of postoperative AF. Comparative studies between amiodarone and placebo demonstrated that the initial treatment with amiodarone reduced the risk of postoperative AF compared with the placebo group. In another study, amiodarone treatment significantly reduced atrial tachyarrhythmias and the risk of sustained ventricular arrhythmias. Also, preoperative amiodarone prophylaxis is helpful to prevent AF occurrence in high-risk patients. However, despite the considerable positive outcomes of AADs in patients undergoing cardiac surgery, some significant clinical difficulties limit the use of these agents. [3, 5]

Treatment

Before initiating the treatment of AF, underlying medical comorbidities like electrolyte imbalance, hypoxia, and COPD should be treated. The treatment of post-CABG AF includes the use of drugs and electrical cardioversion. Drugs can target to achieve rate control or rhythm control. Short-acting beta-blockers are the drug of choice, especially in patients with ischemic heart disease. Among calcium channel blockers, verapamil and diltiazem can be used. Digoxin is less effective when adrenergic tone is high but might be used in patients with congestive heart failure. Amiodarone can also be used and is known to improve hemodynamic status when used intravenously; the risks and benefits of this treatment option include conversion rates.

Discussion

AF is one of the most common adverse events after cardiac surgery. Reported incidences range from 10–40%, depending on patient profile, type of surgery, method of arrhythmia surveillance, and definition of arrhythmia.[1.6.8]

While the precise pathophysiology of POAF is unknown, most evidence suggests it is multifactorial. A common underlying factor associated with POAF induced by mechanical, metabolic, or pharmacologic stimuli is the redox changes in atrial tissue associated with tachyarrhythmia.[9]

POAF adversely affects mortality and morbidity and consequently leads to a more extended hospital stay and higher costs related to the cost of care.[1.10]

Certain preoperative factors predict the development of POAF.

Our study found that advancing age, male sex, history of CKD, low left ventricular ejection fraction, and preoperative beta-blocker treatment are independently associated with the development of POAF.

The characteristics of POAF described in previous studies were transient episodes of AF, usually occurring between two to four days after operation, with a high recurrence rate.[12, 13]

The characteristics of POAF episodes observed in our study are similar to the description from previous studies.

In our study, the median time of development of POAF was 3.7 days after the operation, with most of the first POAF episodes happening within three days. The recurrence rate of POAF was 16%, comparable to the 10-40% recurrence rate seen in previous studies.[12, 13]

Knowing the characteristics of POAF will allow treating healthcare professionals to anticipate POAF better and be more vigilant in monitoring and management.

We decided to select 48 hours as the POAF duration cut-off to categorize patients in favor of the more commonly used 24-hour cut-off period to identify patients who required prophylactic anticoagulation. In total, 8 of our patients had AF duration of more than 48 hours. It was recommended by the management guidelines that they be started on prophylactic anticoagulation for thromboembolic prevention.[14,15]

Conclusion

AF is the most common complication after CABG. The occurrence is not dependent on the type of intervention (only CABG or combined with valve replacement), the number of vessels that underwent bypass grafting, or the type of vessel. Electrolytic imbalance should be assessed during the postoperative course of patients who undergo CABG.

POAF was detected in 16% of patients, which is a good result compared to other studies. Since the rate of AF incidence is considerably high and it could come with morbidities that annoy patients, it is a hot point of research in the field of cardiac science.

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