

Postoperative Atrial Fibrillation after Cardiac Surgery: Who Should Receive Chemoprophylaxis?

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Abstract

To evaluate arrhythmogenic risk factors associated with greater incidence of postoperative atrial fibrillation (POAF) in patients undergoing cardiac surgery (CABG and/or valvular surgery) in order to identify those more prone to the development of this arrhythmia for possible chemoprophylaxis.

Sixty-six patients who underwent elective cardiac surgery were assessed. The following risk factors for the development of POAF were correlated: advanced age, valvular heart disease (VHD), left atrial (LA) enlargement, left ventricular dysfunction (LVD), electrolyte imbalance (EI), previous CABG, prior use and withdrawal of beta-blockers (BB) and/or digitalis 24 hours before surgery).

The incidence of AF was high (47%) in our study, most frequently on the first postoperative day. Sixty-four percent of the study sample was male, and the mean age was 62 years. Among patients with two or less risk factors for AF, only 24% developed arrhythmia, while the presence of three or more risk factors was associated with increased incidence of postoperative AF (69%), ($p = 0.04$). Age ≥ 65 years (58% of the patients) was the most prevalent risk factor, followed by LA enlargement in 45% ($p = 0.001$), and VHD in 38% ($p = 0.02$).

The presence of three or more risk factors increases significantly the incidence of this arrhythmia in the postoperative period after cardiac surgery. Among the primary risk factors are advanced age, left atrial enlargement, and valvular heart disease.

Introduction

Atrial fibrillation (AF) is the most common supraventricular tachyarrhythmia encountered in clinical practice¹. Its

incidence increases with age and it is also three to five times more common in the presence of cardiovascular disease. Atrial fibrillation occurs in approximately 30% of coronary artery bypass grafting (CABG) surgeries and 60% of valvular surgeries, mostly on the second postoperative day²⁻⁸, and it is usually benign. Nevertheless, it may lead to hemodynamic instability, embolic events, and longer intensive care unit (ICU) stays, magnifying the risks associated with major surgeries, such as CABG. Also, this clinical complication increases hospital costs⁹.

Some studies point to advanced age, male gender, prior atrial fibrillation, heart failure, and discontinuation of beta-blockers as preoperative factors associated with greater incidence of this arrhythmia¹⁰⁻¹⁴. Although a number of studies have identified risk factors for postoperative atrial fibrillation after heart surgery, an effective predictive model does not yet exist¹⁵. Appropriate risk stratification may allow identification of vulnerable patients, and preventive measures are recommended for those at higher risk¹⁶.

Method

From August 2004 to February 2005, 66 patients who underwent elective cardiac surgery (CABG and/or valvular surgery) were assessed in an observational, prospective study conducted at a tertiary cardiac referral center in Brazil. They were followed up by continuous cardiac monitoring and serial electrocardiograms for seven days or until hospital discharge. All patients were assessed according to a risk factor protocol to predict atrial fibrillation (Figure 1). The number of arrhythmogenic risk factors for postoperative atrial fibrillation (POAF) in patients undergoing cardiac surgery was correlated. Exclusion criteria were the following:

- Patients with history of atrial fibrillation (paroxysmal or chronic), self-reported or documented by examinations, such as prior ECG or even 24-hour Holter monitoring.
- Patients who were already taking oral antiarrhythmic drugs to maintain sinus rhythm.

Patients who experienced uneventful postoperative courses spent, on average, two days in the coronary care unit (CCU) and were transferred to a regular ward where they remained for five days until discharge. During the CCU stay, the patient was continuously monitored with devices programmed to set off alarms upon any change in heart rate. Each patient was seen twice daily by a physician (during the day and at night) and as needed (by the nursing staff or other

Key words

Atrial fibrillation; risk factors; arrhythmia; postoperative care; thoracic surgery.

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PATIENT			
Type of surgery			
<input type="checkbox"/> CABG		<input type="checkbox"/> Valvular surgery	
Risk factors for atrial fibrillation			
● Age 65 or older	<input type="checkbox"/> YES	<input type="checkbox"/> NO	
● Left atrial overload	<input type="checkbox"/> YES	<input type="checkbox"/> NO	
● Valvular heart disease	<input type="checkbox"/> YES	<input type="checkbox"/> NO	
● Reoperation	<input type="checkbox"/> YES	<input type="checkbox"/> NO	
● Previous atrial arrhythmia	<input type="checkbox"/> YES	<input type="checkbox"/> NO	
● Hypoxemia	<input type="checkbox"/> YES	<input type="checkbox"/> NO	
● Ventricular dysfunction	<input type="checkbox"/> YES	<input type="checkbox"/> NO	
● COPD	<input type="checkbox"/> YES	<input type="checkbox"/> NO	
● Electrolyte imbalance (Hb < 10 g/dL; K < 3.5 or > 5.0 mmol/L)	<input type="checkbox"/> YES	<input type="checkbox"/> NO	
● Prior use of beta-blockers discontinued before surgery	<input type="checkbox"/> YES	<input type="checkbox"/> NO	
● Prior use of digitalis	<input type="checkbox"/> YES	<input type="checkbox"/> NO	
Number of risk factors per patient: _____			
Atrial fibrillation	<input type="checkbox"/> YES	<input type="checkbox"/> NO	
Postoperative day: _____			

Figure 1 - Protocol for risk factors. Hb - hemoglobin ; K - potassium; COPD - chronic obstructive pulmonary disease.

members of the multidisciplinary team, such as physical therapists), and all data were recorded on the medical chart. At the CCU, each physician saw ten patients per 12-hour shift, with one head nurse and one assistant nurse for every two patients, in addition to the multidisciplinary team, with physical therapists on call 24 hours a day. Vital signs (blood pressure, heart rate, axillary temperature, capillary glucose, venous oxygen saturation, urine output, drugs infused, and date when central venous catheter was placed) were monitored on an hourly basis (during the first six hours after CCU admission or as requested by a physician) and then every two hours. At the hospital ward, electrocardiograms (ECG) were recorded daily until hospital discharge, as well as whenever requested by the physician or in cases of significant symptoms, to rule out arrhythmias and other ECG changes. Length of stay in hospital was longer for patients who developed atrial fibrillation.

As for the risk factors summarized in figure 1, which have already been described in the literature as predisposing to postoperative atrial fibrillation, their number and association were determinants of future chemoprophylaxis. Among them, chronic obstructive pulmonary disease (COPD), a syndrome caused by irreversible, chronic, diffuse obstruction

of the lower airways, was characterized by chronic bronchitis and pulmonary emphysema. The former was clinically diagnosed by the presence of productive cough for more than three months of the year for two consecutive years (other causes of cough having been ruled out), and the latter by permanent, abnormal enlargement of the air spaces distal to the terminal bronchiole, accompanied by destruction of their walls, with specific and suggestive signs on chest X-ray (diaphragmatic flattening, lung hyperinflation, bronchial wall thickening, increased retrosternal air space on the lateral view, and increased intercostal spaces). Left ventricular systolic dysfunction was defined as ejection fraction less than 50% on two-dimensional echocardiography. The other risk factors evaluated in this study will not be detailed. It is worth noting that other risk factors, such as extracorporeal circulation (ECC) and postoperative complications, such as need for external pacemaker for bradyarrhythmias, were not considered in this study.

Statistical analysis

Mean ages of the patients were compared using analysis of variance (ANOVA). The relationship between the occurrence of atrial fibrillation and risk factors was evaluated by Fisher's exact test. In order to use the amount of risk factors as a predictive variable for atrial fibrillation and set a cut-off value to produce the most homogeneous groups of patients possible regarding arrhythmia, a multivariate exploratory technique known as classification and regression tree (CART) analysis was performed. The cut-off value for the amount of risk factors was set at three. This cut-off value yielded 70.3% of accurate classification. The statistical significance level was set at 5% ($p < 0.05$).

Results

In our sample, the incidence of atrial fibrillation was high (47%), and was greatest on the first postoperative day (38%). Mean age of patients was 62 years, and 64% were male. When the first and second postoperative days were considered together, the incidence of atrial fibrillation was also high (only 25% on the second day), but it occurred up to the ninth postoperative day. In the multivariate analysis, the cut-off value for the amount of risk factors was set at three. Accordingly, among patients with two or less risk factors for atrial fibrillation (group 1), only 24% developed arrhythmia, while the presence of three or more of these risk factors (group 2) was associated with higher incidence (58%) of postoperative AF ($p = 0.04$) (Figure 2). Age ≥ 65 years (58% of the patients) was the most prevalent risk factor for atrial fibrillation, although no statistically significant difference was found between both groups. This was followed by left atrial enlargement in 45% ($p = 0.001$) and valvular heart disease in 38% ($p = 0.02$). Risk factors, in decreasing order of importance, were as follows: left ventricular dysfunction ($p = 0.2$), electrolyte imbalance ($p = 0.7$), prior cardiac surgery, and use of beta-blockers and/or digitalis (Figure 3). CABG was more frequent (68%) than valvular surgery (Table 1). Mean ICU/CCU stay was five days for patients who experienced arrhythmia and two days for those who did not.

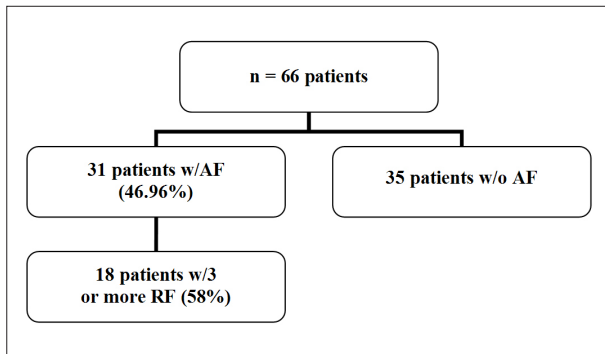


Figure 2 - Incidence of atrial fibrillation and number of risk factors. RF - risk factors; AF - atrial fibrillation; w - with; w/o - without.

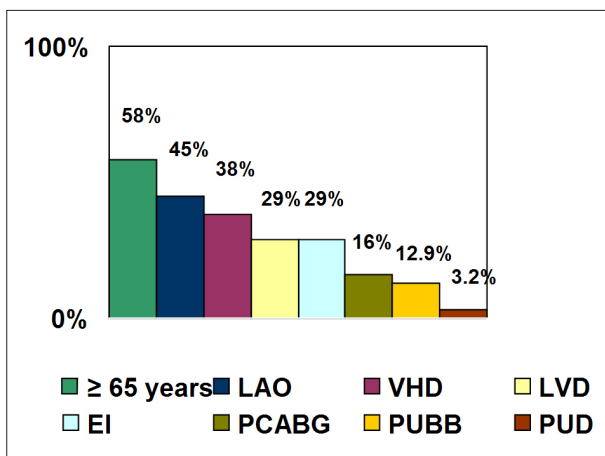


Figure 3 - Primary risk factors for atrial fibrillation, in decreasing order of appearance. LAO - left atrial overload; VHD - valvular heart disease; LVD - left ventricular dysfunction; EI - electrolyte imbalance; PCABG - prior CABG; PUBB - prior use of beta-blockers; PUD - prior use of digitalis.

Discussion

Despite significant improvements in surgical and cardioprotective techniques, the high prevalence of atrial fibrillation following cardiac surgery remains a challenge. Several studies reported in the literature have focused on identifying arrhythmogenic risk factors involved in its etiology, in addition to pharmacological and non-pharmacological prophylactic strategies to decrease the incidence of atrial fibrillation, thereby reducing hospital length of stay and cost¹⁷.

It is important that atrial fibrillation be detected so that an effective prophylactic therapy can be initiated to diminish its morbidity and mortality. In addition to increasing the ICU stay, with its ensuing complications, this arrhythmia is characterized by disorganized electrical activity in the atria, resulting in loss of normal atrial systole. Patients with low ventricular ejection fraction may develop cardiac decompensation, leading to heart failure.

In an observational study with 3,855 patients who underwent cardiac surgery, significant differences were found in mean length of hospital stay in subjects with and without atrial fibrillation. In this study, ICU stay was two times longer

Table 1 - Distribution of atrial fibrillation per type of surgery

Type of Surgery	Atrial Fibrillation		Total
	Yes	No	
MC	6.7	0.0	3.4
CABG	53.3	92.9	72.4
CABG + MVP	6.7	0.0	3.4
CABG + MVR	6.7	0.0	3.4
AVR	13.3	7.1	10.3
MVR	13.3	0.0	6.9
Total	100	100	100

for those who developed atrial fibrillation¹⁷.

It is known that chronic atrial fibrillation is associated with stroke; therefore its prevention during the postoperative period may reduce the risk of this morbidity. However, strokes and transient ischemic attacks (TIA) after cardiac surgery occur in less than 3% of patients, making it difficult to demonstrate a statistically significant benefit from AF prevention¹⁸.

Knowing the risk factors for postoperative atrial fibrillation in patients undergoing cardiac surgery seems to be paramount for the development of prophylactic and therapeutic strategies against this arrhythmia^{19,20}. However, an accurate selection of patients who may benefit from prophylactic therapy for atrial fibrillation requires an appropriate stratification.

In our study, patients with two or less risk factors did not have a statistically significant risk for the development of atrial fibrillation, unlike those with three or more risk factors. This finding enables the identification of potential candidates for prophylaxis of arrhythmia.

In the Framingham study, which followed up 5,191 subjects of both genders between 30 and 62 years old for 22 years, age was found to be the most significant risk factor for atrial fibrillation. This finding is consistent with other studies reported in the literature^{2,4,10,21}, probably owing to the higher content of atrial collagen in elderly patients²².

Patients who develop atrial fibrillation tend to be older (65.9 vs 61.7 years of age, $p = 0.0005$), and the incidence rises progressively in patients older than 75 years. A logistic regression analysis of postoperative variables has identified left atrial overload, advanced age, and male gender as independent predictors of atrial fibrillation²³.

In our study, age difference between the group with two or less risk factors and that with three or more risk factors was not significant, probably because of the advanced age of the sample (mean of 62 years). Nevertheless, age ≥ 65 years was the most prevalent risk factor.

Another study, also based on the Framingham population, followed up subjects between the ages of 59 and 90 during 7.2 years and demonstrated that the echocardiographic variables most related to greater risk of atrial fibrillation were left atrial enlargement, reduced left ventricular fractional

shortening, and left ventricular hypertrophy. The pathologic relationship with age, an important risk factor, seems to result from anatomic changes in the atrium, contributing to greater susceptibility or not to this arrhythmia⁹.

A multivariate logistic regression analysis has identified the following postoperative predictors of atrial fibrillation: advanced age (70 to 80 years), male gender, hypertension, need for intra-aortic balloon pump, postoperative pneumonia, mechanical ventilation for longer than 24 hours, and return to the intensive care unit¹⁰.

The use of adrenergic drugs also appears to be an independent factor for the development of atrial fibrillation²⁴.

The combination of CABG and valvular surgery may increase the incidence of postoperative atrial fibrillation²⁵, a finding that reinforces the inclusion of valvular heart disease as one of the major risk factors for this arrhythmia, as mentioned in the conclusion of our study.

Based on literature data, we sought to correlate the primary risk factors for atrial fibrillation in patients undergoing cardiac surgery, such as advanced age, left atrial enlargement, valvular surgery, and chronic obstructive pulmonary disease²⁶.

Our study confirmed the high incidence of atrial fibrillation following cardiac surgery, which increased significantly in the presence of three or more risk factors, particularly advanced age, left atrial enlargement, and valvular heart disease, followed by left ventricular dysfunction, electrolyte imbalance,

prior CABG, and withdrawal of beta-blockers.

However, accurate risk stratification will allow identification of patients at high risk for postoperative atrial fibrillation²⁷. An appropriate prophylactic therapy in selected patients may reduce the occurrence of this arrhythmia and its inherent complications, as well as length of hospital stay, as was demonstrated in our study, since prolonged ICU/CCU stays significantly increase public health costs.

Conclusion

The presence of three or more risk factors significantly increases the incidence of this arrhythmia in the postoperative course of cardiac surgery. Foremost among risk factors are advanced age, left atrial enlargement, and valvular heart disease.

Potential Conflict of Interest

No potential conflict of interest relevant to this article was reported.

Sources of Funding

There were no external funding sources for this study.

Study Association

This study is not associated with any graduation program.

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