Risk index proposal to predict atrial fibrillation after cardiac surgery

Proposta de escore de risco para predição de fibrilação atrial após cirurgia cardíaca

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Abstract
Objective: Atrial fibrillation (AF) is a common complication following cardiac surgery and is associated with an increased patient morbidity and mortality. The objective of this study was to develop a risk index proposal to predict AF after cardiac surgery. Methods: A prospective observational study in that 452 patients were selected to assess the incidence and risk factors associated with postoperative AF. Only patients following cardiac surgery were selected. Continuous cardiac monitor and daily electrocardiogram were assessed. The most associated in a multivariable logistic model were selected for the risk index.

Results: The average incidence of AF was 22.1%. The most associated factors with AF were: patients older than 75 years of age, mitral valve disease, no use of a beta blocker, withdrawal of a beta-blocker and a positive fluid balance. The absence risk factor determined 4.6% chance to postoperative AF, and for one, two and three or more risk factors, the chance was 16.6%, 25.9% and 46.3%, respectively.

Conclusion: In a multivariable logistic model was possible to develop a risk index proposal to predict postoperative AF with a major risk of 46.3% in the presence of three or more risk factors.


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Article received on October 13rd, 2009
Article accepted on April 5th, 2010
The postoperative period of cardiac surgery is a period of high predisposition to develop AF, reaching an incidence of 10% to 50% of the patients [10-13]. The incidence of postoperative AF has its peak in the second and third postoperative days [3].

Several prophylactic measures for the onset of postoperative AF are reported in the literature, including the use of magnesium, amiodarone, digoxin, steroids and beta blockers, the latter being of greater viability and effectiveness [14].

Advanced age is the risk factor most frequently associated with postoperative AF. Other risk factors associated with AF in the postoperative period of cardiac surgery are: male gender, previous history of AF, hypertension, valvular disease, left ventricular hypertrophy, left heart failure, chronic obstructive pulmonary disease, suspension of beta-blockers, coronary stenosis, systemic inflammatory response syndrome, sepsis and need for mechanical ventilation support [2, 12 - 16].

In addition to expanding costs, readmissions and prolongation of hospital stay, AF leads to a worsened prognosis of the patient, resulting in increased morbidity and mortality [10-13]. The high incidence of AF in the postoperative of cardiac surgery points to the importance of identifying patients at high risk for developing this arrhythmia. The benefit of preventive and therapeutic measures have been proposed for the study of the genesis of this arrhythmia.

**Resumo**

**Objetivo:** A fibrilação atrial (FA) é uma complicação frequente após cirurgia cardíaca e está associada ao aumento na morbidade e mortalidade dos pacientes. O objetivo deste estudo foi desenvolver uma proposta de escore de risco para FA após cirurgia cardíaca.

**Métodos:** Estudo prospectivo observacional, no qual 452 pacientes foram selecionados para avaliação da incidência e fatores de risco associados com FA pós-operatória. Foram selecionados somente pacientes submetidos à cirurgia cardíaca. A avaliação utilizou monitoramento cardíaco contínuo e eletrocardiograma diário. Os fatores com maior associação em modelo de regressão logística multivariável foram selecionados para o escore de risco.

**Resultados:** A incidência média de FA foi de 22,1%. Os fatores mais associados com FA foram: pacientes com mais de 75 anos de idade, doença valvar mitral, não utilização de betabloqueador, interrupção do uso de betabloqueador e balanço hídrico positivo. A ausência fator de risco determinou 4,6% de chance de FA pós-operatória e para um, dois e três ou mais fatores de risco a chance foi, respectivamente, de 16,6%, 25,9% e 46,3%.

**Conclusão:** Em modelo de regressão logística multivariada foi possível estabelecer uma proposta para escore de risco para predição de FA pós-operatória, com um risco máximo de 46,3% na presença de três ou mais fatores de risco.

**Descritores:** Fibrilação atrial. Cirurgia torácica. Fatores de risco. Medição de risco.
of AF in the postoperative period. Thus, this study aimed to develop a proposal for a risk score for the incidence of AF after cardiac surgery.

METHODS

The present study consists of a prospective, observational analysis, in which 448 patients were enrolled at the Institute of Cardiology/University Foundation of Cardiology of Rio Grande do Sul (IC-FUC).

We selected adult patients undergoing CABG or valve surgery with or without cardiopulmonary bypass. Patients with AF or with history of paroxysmal or permanent AF preoperatively were excluded. Patients were selected during the immediate postoperative period in the Postoperative Unit Number I (POU I) of the IC-FUC. This study included analysis of a sample of patients obtained in two separate years.

Patients were selected systematically. The sample included all patients undergoing cardiac surgery on a given weekday, and in each week the day of selection was different, consecutively, from Monday to Friday. All patients enrolled in the study were followed until the day of hospital discharge.

Assessment of each patient was divided into four phases: immediate postoperative phase, intensive care unit (ICU) postoperative (POU I and II), post-ICU (nursing beds) and day of discharge from hospital. In each of the four phases, we used a protocol previously approved by the Research Ethics Committee of the IC-FUC in which there were the data to be searched.

All patients who met the inclusion criteria signed a written informed consent approved by the Research Ethics Committee of the IC-FUC. Failure to sign the informed consent resulted in the exclusion of the patient. In the selection phase, the demographics and preoperative data have been chosen for survey.

All patients were examined personally by the researchers. Surveys were also analyzed pre- and postoperatively. In the phase of ICU - postoperative and in the phase of discharge from ICU, patients were assessed daily, from the clinical and laboratory point of view.

Cardiac rhythm was assessed by continuous cardiac monitoring in all patients for a minimum of 72 hours (postoperative ICU) and by daily electrocardiographic examinations until hospital discharge.

Additional electrocardiographic exams were performed when the patients reported palpitations, tachycardia or angina pectoris.

It was considered AF any episode of supraventricular arrhythmia whose electrocardiographic tracing showed “f” waves of variable morphology and amplitude, with irregular ventricular rhythm. There were considered for the study episodes of AF lasting at least 15 minutes or requiring treatment due to symptoms or hemodynamic instability.

Statistical analysis

During the selection and analysis of the patients, there was the implementation of a protocol for prevention of AF after cardiac surgery. This protocol was implemented by the establishment of an independent and not linked manner to this study. Thus, it became necessary to compare clinical and demographic data between patients by Student’s t test for independent samples.

Through a derivation cohort, risk factors were associated with postoperative AF. Among these factors it was developed a score of chances on which were selected the risk factors independently associated with postoperative AF in multivariate logistic regression model with backward selection ($P < 0.05$).

Data analysis was performed using the Statistical Package for Social Sciences (SPSS) version 12.0 (Chicago, Illinois, USA).

RESULTS

This study included the screening of 448 patients over a period of two years. Patients selected before and after implementation of routines for prevention of AF were, respectively, 145 and 303 individuals. Faced with the comparison of clinical and demographic characteristics, no statistically significant differences at baseline were found. So, as a single sample, the average age was 61 years (sd = 12), being 25% over 70 years. Males constituted 64% of the sample.

In all patients, we obtained an incidence of 22.1% (n = 99) of postoperative AF.

Univariate analysis of the derivation cohort showed that significant risk factors for AF were: age over 70 years, diabetes, mitral and aortic valve disease, dyspnea, dyslipidemia, left heart failure (LHF), beta-blockers discontinued and increased total fluid balance. These variables were defined by clinical, laboratory and radiographic findings, according to the literature. Only the use of beta-blockers or not was considered (Table 1).

Among all risk factors mentioned above, which showed strong association in multivariate logistic regression with postoperative AF, according to their clinical relevance were: age over 70 years, mitral valve disease, the use or discontinuation of beta-blockers and fluid balance above 1500 ml. These factors were used for composition of the risk score for prediction of AF (Table 2).

The proposed risk score is shown in Figure 1 in graph form, where it can be observed the increasing line of risk in relation to the increased number of associated factors (Figure 1).
DISCUSSION

During the development of this proposal of risk score, this study examined patients in the postoperative period of cardiac surgery. Some studies have sought to establish the main factors associated with postoperative AF.

This study showed that age above 70 years is strongly associated with AF in the postoperative period of cardiac surgery (P < 0.001). Among the patients over 70 years, 33.1% developed AF during the hospital stay. The model of Zaman et al. [17] sought to highlight the preoperative risk of AF after CABG. This study used age above 60 years, enlarged P wave (greater than 155 ms, suggesting atrial overload) and male gender as risk factors. Patients with three risk factors were considered at high risk for developing postoperative AF. Mathew et al. [18] in a prospective and multicenter study, also developed an index for risk of atrial fibrillation after cardiac surgery, in which factors considered independently associated with postoperative AF were age, previous history of AF, valve surgery, chronic obstructive pulmonary disease and discontinuation of beta blockers or angiotensin converting enzyme 1.

Literature reports any patient over 70 years as high-risk patient for developing AF. In addition, it is also known that every 10 years of patient’s age, the risk of postoperative AF increased 75% [17,19]. Advanced age is associated with changes in connective tissue and atrial dilatation, and may cause changes in electrical conduction and thereby also increasing the chance of FA. Most of these patients suffer from hypertension and left ventricular hypertrophy, which further predispose the atrium to the development of AF.

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**Table 1. Risk factors for development of AF after cardiac surgery in univariate analysis using the chi-square test.**

<table>
<thead>
<tr>
<th>Variables</th>
<th>With AF</th>
<th>Without AF</th>
<th>OR</th>
<th>CI 95%</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age &gt; 70 years</td>
<td>35.7</td>
<td>17.5</td>
<td>2.62</td>
<td>1.60-4.23</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Diabetes</td>
<td>22.4</td>
<td>31.9</td>
<td>0.62</td>
<td>0.36-1.04</td>
<td>0.09</td>
</tr>
<tr>
<td>Mitral valve disease</td>
<td>16.3</td>
<td>7.6</td>
<td>2.36</td>
<td>1.22-4.59</td>
<td>0.016</td>
</tr>
<tr>
<td>Aortic valve disease</td>
<td>35.7</td>
<td>21.8</td>
<td>1.99</td>
<td>1.23-3.24</td>
<td>0.007</td>
</tr>
<tr>
<td>Dyspnea</td>
<td>54.1</td>
<td>36.2</td>
<td>2.08</td>
<td>1.32-3.27</td>
<td>0.002</td>
</tr>
<tr>
<td>Dyslipidemia</td>
<td>29.6</td>
<td>43.2</td>
<td>0.55</td>
<td>0.34-0.89</td>
<td>0.02</td>
</tr>
<tr>
<td>LHF</td>
<td>57.1</td>
<td>39</td>
<td>2.08</td>
<td>1.33-3.28</td>
<td>0.002</td>
</tr>
<tr>
<td>Interrupted beta-blocker</td>
<td>64.3</td>
<td>41.5</td>
<td>2.53</td>
<td>1.60-4.03</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Total hydric balance (mean + sd)</td>
<td>2690 ± 1784</td>
<td>2084 ± 1603</td>
<td>0.001</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**AF:** Atrial Fibrillation; **OR:** Odds ratio; **CI:** Confidence Interval; **LHF:** Left Heart Failure

**Table 2. Risk factors are defined as high association with postoperative AF by multivariate logistic regression model.**

<table>
<thead>
<tr>
<th>Variable</th>
<th>B</th>
<th>P</th>
<th>OR</th>
<th>CI 95%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age &gt; 70 years</td>
<td>0.98</td>
<td>&lt;0.001</td>
<td>2.67</td>
<td>1.59 – 4.48</td>
</tr>
<tr>
<td>Mitral Valve Disease</td>
<td>0.77</td>
<td>0.03</td>
<td>2.18</td>
<td>1.08 – 4.35</td>
</tr>
<tr>
<td>No use of beta-blocker or discontinuation of its use in the postoperative</td>
<td>0.91</td>
<td>&lt;0.001</td>
<td>2.49</td>
<td>1.53 – 4.03</td>
</tr>
<tr>
<td>Total water balance &gt; 1500 ml</td>
<td>0.5</td>
<td>0.06</td>
<td>1.65</td>
<td>0.96 – 2.83</td>
</tr>
<tr>
<td>Constant</td>
<td>-2.471</td>
<td>&lt;0.001</td>
<td>0.08</td>
<td></td>
</tr>
</tbody>
</table>

**OR:** Odds ratio; **CI:** Confidence Interval

**Fig. 1 - Increased risk (expressed in%) for the occurrence of postoperative AF in accordance with the number of risk factors present. The bars represent the confidence interval of 95% (P < 0.001)**
REFERENCES


