Predicting risk of atrial fibrillation after heart valve surgery: evaluation of a Brazilian risk score

Predizendo risco de fibrilação atrial após cirurgia cardíaca valvar: avaliação de escore de risco brasileiro

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Abstract

Objective: The aim of this study is to evaluate the applicability of a Brazilian score for predicting atrial fibrillation (AF) in patients undergoing heart valve surgery in the Division of Cardiovascular Surgery of Pronto Socorro Cardiológico de Pernambuco - PROCAPE (Recife, PE, Brazil).

Methods: Retrospective study involving 491 consecutive patients operated between May/2007 and December/2010. The registers contained all the information used to calculate the score. The outcome of interest was AF. We calculated association of model factors with AF (univariate analysis and multivariate logistic regression analysis), and association of risk score classes with AF.

Results: The incidence of AF was 31.2%. In multivariate analysis, the four variables of the score were predictors of postoperative AF: age >70 years (OR 6.82; 95%CI 3.34-14.10; *P*<0.001), mitral valve disease (OR 3.18; 95%CI 1.83-5.20; *P*<0.001), no use of beta-blocker or discontinuation of its use in the postoperative period (OR 1.63; 95%CI 1.05-2.51; *P*=0.028), total fluid balance > 1500 ml at first 24 hours (OR 1.92; 95%CI 1.28-2.88; *P*=0.002). We observed that the higher the risk class of the patient (low, medium, high, very high),

the greater is the incidence of postoperative AF (4.2%; 18.1%; 30.8%; 49.2%), showing that the model seems to be a good predictor of risk of postoperative AF, in a statistically significant association (*P*<0.001).

Conclusions: The Brazilian score proved to be a simple and objective index, revealing a satisfactory predictor of development of postoperative AF in patients undergoing heart valve surgery at our institution.

Descriptors: Atrial fibrillation. Heart valve diseases. Postoperative period.

Resumo

Objetivo: O objetivo deste estudo é avaliar a aplicabilidade de um escore brasileiro na predição de fibrilação atrial (FA) pós-operatória em pacientes submetidos à cirurgia cardíaca valvar na Divisão de Cirurgia Cardiovascular do Pronto Socorro Cardiológico de Pernambuco - PROCAPE (Recife, PE, Brasil).

Métodos: Estudo retrospectivo envolvendo 491 pacientes consecutivos operados entre maio/2007 e dezembro/2010. Os registros continham todas as informações utilizadas para

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Sá MPBOL, et al. - Predicting risk of atrial fibrillation after heart valve surgery: evaluation of a Brazilian risk score

Rev Bras Cir Cardiovasc 2012;27(1):117-22

Abbreviations, acronyms & symbols	
AF	atrial fibrillation
BB	beta-blockers
CABG	coronary artery bypass graft
CI	confidence interval
COPD	chronic obstructive pulmonary disease
CPB	cardiopulmonar bypass
EF	ejection fraction
LCOS	low cardiac output syndrome
NYHA	New York Heart Association
OR	odds ratio
TFB	total fluid balance

calcular a pontuação. O desfecho de interesse foi FA. Calculamos associação de fatores do escore com FA (análise univariada e análise de regressão logística multivariada), e associação de classes de risco do escore com FA.

Resultados: A incidência de FA foi de 31,2%. Na análise multivariada, as quatro variáveis do escore foram preditores de FA pós-operatória: idade> 70 anos (OR 6,82; IC95% 3,34-14,10; *P*<0,001), doença valvular mitral (OR 3,18; IC95% 1,83-5,20; *P*<0,001), sem uso de beta-bloqueador ou interrupção de seu uso no pós-operatório (OR 1,63; IC95% 1,05-2,51; *P*=0,028), balanço hídrico total >1500 ml nas primeiras 24 horas (OR 1,92; IC95% 1,28-2,88; *P*=0,002). Observamos que, quanto maior a classe de risco do paciente (baixa, média, alta, muito alta), maior é a incidência de FA pós-operatória (4,2%; 18,1%; 30,8%; 49,2%), mostrando que o modelo parece ser um bom preditor de risco de FA pós-operatória, em uma associação estatisticamente significativa (*P*<0,001).

Conclusões: O escore brasileiro revelou-se um índice simples e objetivo, revelando-se um preditor satisfatório de desenvolvimento de FA pós-operatória em pacientes submetidos à cirurgia cardíaca valvar em nossa instituição.

Descritores: Fibrilação atrial. Doenças das valvas cardíacas. Período pós-operatório.

INTRODUCTION

The postoperative period of cardiac surgery is a period of high predisposition to development of atrial fibrillation (AF), reaching an incidence of 10% to 50% of patients [1-3]. In addition to expanding costs, readmissions and prolonged hospitalization, AF leads to a worsening prognosis of the patient resulting in a higher morbidity and mortality [1-3]. The high incidence of postoperative AF in cardiac surgery alert to the importance of identifying patients at high risk for developing this arrhythmia.

Silva et al. [4] recently proposed a Brazilian risk score for prediction of AF after cardiac surgery. However, several studies show that risk prediction scores tend to have inferior performance when applied to different groups of patients which have been used to development of the original model [5]. So the external assessment in population of patients with new data from other institutions is always important for the score has wide clinical application [6,7].

The objective of this study is to evaluate the ability of the score of Silva et al. [4] in predicting risk of AF in our institution, specifically in the group undergoing valvular heart surgery.

METHODS

Source population

After approval by the ethics committee, process number 46/2010, in accordance with Resolution 196/96 (National Board of Health - Ministry of Health – Brazil) [8,9], we reviewed the records of patients undergoing consecutive isolated heart valve surgery (replacement or repair) or combined with coronary artery bypass graft surgery at the Division of Cardiovascular Surgery of Pronto Socorro Cardiológico de Pernambuco (PROCAPE) from May 2007 to December 2010 - the clinical and surgical profile of the studied population is described in Table 1. We excluded the following: patients whose records did not contain the necessary data concerning the variables to be studied; patients undergoing surgery for tricuspid and/or pulmonary valves (when isolated, due to small number of patients undergoing these procedures); patients with preoperative AF; age < 18 years.

Study design

It was a retrospective study of exposed and nonexposed to certain factors (independent variables) with outcome (dependent variable) followed by assessment of a model (the score of Silva et al. [4]).

The independent variables were: age (years), gender (male or female), mitral valve disease (yes/no), no use of beta-blocker or discontinuation of its use in the postoperative period (yes/no), total fluid balance > 1500 ml at first 24 hours (yes/no).

The dependent variable was AF after surgical procedure. This variable was categorized into yes or no. It was considered AF any episode of acute 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 at least 15 minutes or requiring treatment due to symptoms or hemodynamic instability.

Sá MPBOL, et al. - Predicting risk of atrial fibrillation after heart valve surgery: evaluation of a Brazilian risk score

Rev Bras Cir Cardiovasc 2012;27(1):117-22

Table 1.   Clinical and surgical profile of studied population

Variable	n	%
Total	491	100.0
Age > 70 years	45	9.2
Female gender	252	51.5
Systemic arterial hypertension	193	39.3
Diabetes	146	29.7
Obesity	70	14.3
Smoking	191	38.9
COPD	58	11.8
Creatinine (1,5 a 2,49 mg/dL)	58	11.8
Creatinine (> 2,50 mg/dL or preoperative dialysis)	23	4.7
NYHA Class (III – IV)	270	55.0
EF < 45%	81	16.5
Pulmonary arterial hypertension	121	24.6
Mitral valve disease	356	72.5
Aortic valve disease	170	34.6
Previous cardiac surgery	82	16.7
No use of â-blocker or discontinuation of its use in postoperative period	313	63.7
Emergency surgery	52	10.6
Combined CABG	43	8.8
CPB time > 90 minutos	186	37.9
Total fluid balance > 1500 ml at first postoperative 24 hours	237	48.3
Vasoactive drugs in postoperative period	181	36.9
Postoperative LCOS	72	14.7

COPD: chronic obstructive pulmonary disease; NYHA: New York Heart Association; EF: ejection fraction; CABG: coronary artery bypass graft; CPB: cardiopulmonar bypass; LCOS: low cardiac output syndrome

Each patient was evaluated for the presence or absence of the four risk factors established by Silva et al. [4], respecting the definition of each of them and giving them the correct score (Table 2). Depending on the final score, each patient was placed in one of the four risk groups (Table 3). We recorded the outcomes (development or non-development of AF).

Table 2.   Factors associated with development of atrial fibrillation after cardiac surgery and appropriate score

Clinical profile	Score
Age > 70 years	1
Mitral valve disease	1
No use of beta-blocker or discontinuation of its use in postoperative period	1
Total fluid balance > 1500 ml at first 24 hours	1

Table 3.   Risk group class according to the score

Risk group	Total score
Low	0
Medium	1
High	2
Very high	3 or more

Statistical methods

Data were analyzed using percentage and descriptive statistics measures. The following tests were used: chi-square test or Fisher's exact test (as appropriate, for non-parametric variables). In the study of univariate association between categorical variables, the values of the Odds Ratio (OR) and a confidence interval (CI) for this parameter with a reliability of 95% were obtained.

Multivariate analysis was adjusted to a logistic regression model to explain the proportion of patients who developed AF that were significantly associated to the level of 5.0% ($P < 0.05$) by a backward elimination procedure. The calibration of multivariate model was evaluated by the Hosmer-Lemeshow goodness-of-fit test.

The level of significance in the decision of the statistical tests was 5%. The program used for data entry and retrieval of statistical calculations was SPSS (Statistical Package for Social Sciences) version 15.0.

RESULTS

Incidence of AF and population characteristics

Taking into account the inclusion and exclusion criteria, we analyzed 491 patients undergoing heart valve surgery

Sá MPBOL, et al. - Predicting risk of atrial fibrillation after heart valve surgery: evaluation of a Brazilian risk score

Rev Bras Cir Cardiovasc 2012;27(1):117-=22

with a mean age of 44.6 ± 17.9 years, being 51.5% female. The following clinical features were observed: 9.2% was aged above 70 years, 72.5% had mitral valve disease, 63.7% had no use of beta-blocker or discontinuation of its use in the postoperative period, and 48.3% had total fluid balance > 1500 ml at first 24 hours. Postoperative AF was diagnosed in 153 (31.2%) patients.

Univariate analysis

Analyzing the variables proposed in the score with the occurrence of postoperative AF, we observed that all of them were significantly associated with this complication (Figure 1).

Multivariate analysis

Applying a multivariate logistic regression model, associations of clinical variables of the score remained strongly associated with postoperative AF (Table 4). The model was well accepted (*P*<0.001) and showed a degree of explanation of 71.1%. The Hosmer-Lemeshow goodness-of-fit was also well accepted (*P*=0.281), indicating a good model calibration.

Analysis of the score and prediction of AF

The incidence of postoperative AF according to the risk score classification is showed in Figure 2. We observed that the higher is the risk group, the higher is the incidence of postoperative AF, in a statistically significant association (*P*<0.001).

DISCUSSION

We observed in our study an incidence of 31.2% of postoperative AF. This is 41.2% greater than that observed in the original study by Silva et al. [4], which was 22.1%. This is probably because our population is composed only by patients undergoing heart valve surgery (all with cardiopulmonary bypass and bicaval cannulation), different from the population of Silva et al. [4], which also consisted of patients undergoing exclusive coronary artery bypass graft surgery with or without cardiopulmonary bypass, beyond valve surgeries. Many studies have shown that bicaval cannulation and cardiopulmonary bypass increase the risk of postoperative AF [10-12]. These factors may create a bias and interfering with the greater incidence of postoperative AF in our population.

We identified in our study that age >70 years was independently associated with postoperative AF, in statistically significant association. Advanced age is associated with changes in connective tissue and atrial
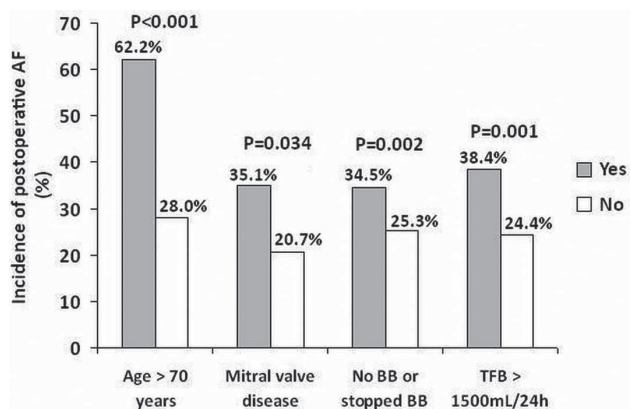

Fig. 1 - Association of clinical characteristics with the occurrence of postoperative AF after heart valve surgery (univariate analysis). AF: atrial fibrillation; BB: beta-blockers; TFB: total fluid balance
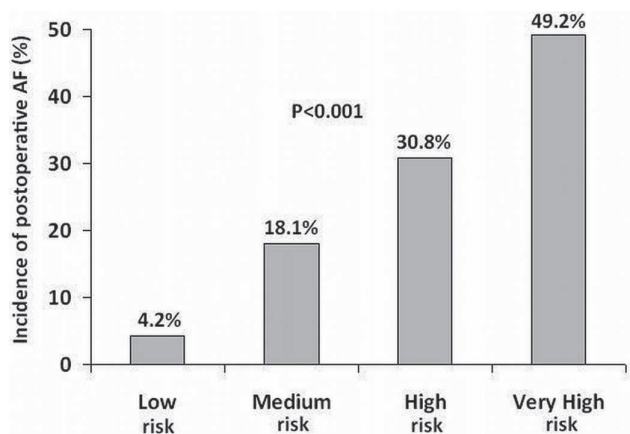

Fig. 2 - Relationship between the risk group classification according to the score and incidence of postoperative atrial fibrillation. AF: atrial fibrillation

Table 4. Multivariate logistic regression model

Variable	OR (95.0% CI)		*P*-value
	Univariate analysis	Multivariate analysis	
Age > 70 years	4.23 (2.24–8.00)	6.82 (3.34–14.10)	<0.001*
Mitral valve disease	2.07 (1.29–3.31)	3.18 (1.83–5.20)	<0.001*
No use of beta-blocker or discontinuation of its use in postoperative period	1.56 (1.03–2.35)	1.63 (1.05–2.51)	0.028*
Total fluid balance > 1500 ml at first 24 hours	1.93 (1.31–2.84)	1.92 (1.28–2.88)	0.002*

(*): Significant difference at 5 %. Constant P *<0.001*

Sá MPBOL, et al. - Predicting risk of atrial fibrillation after heart valve surgery: evaluation of a Brazilian risk score

Rev Bras Cir Cardiovasc 2012;27(1):117-22

dilatation, and may cause changes in electrical conduction and thereby also increasing the chance of AF [13]. Most of these patients suffer from hypertension and left ventricular hypertrophy, which further predispose the atrium to the development of AF [14].

We recognized in our study that mitral valve disease was independently associated with postoperative AF, in statistically significant association. These patients are, in general, patients with dilated left atrium, which predisposes the onset of AF in patients with sinus rhythm preoperatively and is a predictor of persistence of abnormal rhythm in those who are already suffering from AF preoperatively [15].

We demonstrated in our study that no use of beta-blocker or discontinuation of its use in postoperative period was independently associated with postoperative AF, in statistically significant association. Although it is considered a multifactorial etiology, the postoperative AF can be initiated after an exaggerated response to adrenergic stimulation due to incomplete myocardial protection, without the use of beta-blockers in the immediate postoperative period [15,16]. A study showed that discontinuation of betablockers in the immediate postoperative period resulted in 91% increase in the occurrence of postoperative AF [15].

Another aspect that caught our attention was that total fluid balance > 1500 ml in the first 24 hours was independently associated with postoperative AF, in statistically significant association. A study demonstrated that there is an increase of 1% risk of developing AF for each 1 ml above the average of total fluid balance [16]. It is suggested therefore that the arrhythmia can be triggered by atrial distension caused by fluid retention [17].

We showed that the higher the risk class of the patient, the greater is the incidence of postoperative AF, showing that the model seems to be a good predictor of risk of postoperative AF, in a statistically significant association (*P*<0.001).

CONCLUSIONS

The risk score proposed by Silva et al. [4] seems to be a good model for prediction of postoperative AF in patients undergoing heart valve surgery.

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Sá MPBOL, et al. - Predicting risk of atrial fibrillation after heart valve surgery: evaluation of a Brazilian risk score

Rev Bras Cir Cardiovasc 2012;27(1):117-22

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