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Assessment of the EuroSCORE as a predictor for mortality in myocardial revascularization surgery at the Heart Institute of Pernambuco

Avaliação do EuroSCORE como preditor de mortalidade em cirurgia de revascularização miocárdica no Instituto do Coração de Pernambuco

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Abstract

Objective: **To assess the applicability of the European Risk Score System in Cardiac Operations (EuroSCORE) in patients undergoing myocardial revascularization at the Heart Institute of Pernambuco.**

Method: **From 2003 to 2004, 759 patients underwent myocardial revascularization. For the study, seven were excluded due to the lack of information on one aspect or another involved in obtaining the EuroSCORE. In order to assess the applicability of the EuroSCORE, an adjustment was made using a logistic regression model of operative mortality (response variable) on the EuroSCORE (explanatory variable). The calibration of the model was measured by comparing the morbidity observed with that expected, using the Hosmer-Lemeshow Test of Goodness of Fit. The accuracy of the model was evaluated by means of Statistics-c.**

Results: **The accuracy of the model, estimated at 69.9%, and the calibration (Hosmer-Lemeshow test, p=0.663) were satisfactory. The total predicted mortality was practically identical to the observed – 1.7%. The low-risk group (EuroSCORE: 0-2) comprised 231 patients and had two (0.87%) deaths within this group. The medium-risk group (EuroSCORE: 3-5) comprised 268 patients and one (0.37%) death occurred. The high-risk group (EuroSCORE: =6) comprised 253 patients and ten (3.95%) deaths occurred. The discrepancies between the percentages of deaths observed in these groups and those predicted by the model were not statistically significant on the basis of the result of the chi-square test (p=0.624).**

Conclusion: **The EuroSCORE, a simple and objective index, proved to be a satisfactory predictor of operative mortality in patients submitted to myocardial revascularization in the Heart Institute of Pernambuco.**

Descriptors: **Myocardial revascularization. Epidemiologic methods. Severity of illness index. Risk assessment, methods. Survival analysis. Mortality.**

Study performed at Instituto do Coração de Pernambuco. Real Hospital Português in Pernambuco.

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Resumo

Objetivo: **Avaliar a aplicabilidade do Sistema Europeu de Risco em Operações Cardíacas (EuroSCORE) em pacientes submetidos à revascularização miocárdica no Instituto do Coração de Pernambuco.**

Método: **Durante os anos de 2003 e 2004, 759 pacientes foram submetidos à revascularização miocárdica. Desse total, sete doentes foram excluídos por ausência de informações relativas a algum dos fatores envolvidos na obtenção do EuroSCORE. Para avaliar a aplicabilidade do EuroSCORE, foi realizado o ajuste de um modelo de regressão logística da mortalidade operatória (variável resposta) sobre o EuroSCORE (variável explanatória). A calibração do modelo foi mensurada comparando–se a mortalidade observada com a esperada, utilizando o teste de bondade de ajuste de Hosmer–Lemeshow. A acurácia do modelo foi avaliada através da estatística–c.**

Resultados: **Foram satisfatórias a acurácia do modelo, estimada em 69,9%, e a calibração (valor p do teste de Hosmer–Lemeshow igual a 0,663). A mortalidade total prevista foi praticamente idêntica à observada, 1,7%. O grupo de baixo risco (EuroSCORE: 0-2) tinha 231 pacientes e ocorreram dois (0,87%) óbitos. O grupo de médio risco (EuroSCORE: 3-5) tinha 268 pacientes e ocorreu 1 (0,37%) óbito. O grupo de alto risco (EuroSCORE: ≥6) apresentava 253 pacientes e houve 10 (3,95%) óbitos. As discrepâncias entre as porcentagens de óbitos observadas nesses grupos e aquelas previstas pelo modelo não foram estatisticamente significantes, de acordo com o resultado do teste qui-quadrado (p = 0,624).**

Conclusão: **O EuroSCORE, um índice simples e objetivo, mostrou-se como um preditor satisfatório de mortalidade operatória, em pacientes submetidos à revascularização miocárdica no Instituto do Coração de Pernambuco.**

Descritores: **Revascularização miocárdica. Métodos epidemiológicos. Índice de gravidade de doença. Medição de risco, métodos. Análise de sobrevivência. Mortalidade.**

INTRODUCTION

Several models of risk stratification have been idealized to predict mortality in cardiac surgery [1-7]. The European system for the assessment of risk in cardiac surgery (EuroSCORE) first started to be outlined in 1995, when information on risk factors and mortality were collected from 19030 adult patients consecutively submitted to heart surgery at 128 centers in eight European countries [8]. Sixty-eight preoperative and 29 operative factors risks, which may influence hospital mortality were analyzed. The relationship between different risk factors and the results was statistically studied using univariate analysis and logistic regression. This allowed the identification of 17 real risk factors and, for each of them, a score was attributed, thereby creating a model that allows the division of patients into three risk groups: low-risk (score from 0 to 2), medium-risk (score from 3 to 5) and high-risk (score > 6)[9]. This model of risk stratification has been highly effective, even when applied to non-European populations [10, 11].

The aim of this study was to assess the applicability of the EuroSCORE in patients submitted to myocardial revascularization at the Heart Institute of Pernambuco.

METHOD

The records of 759 patients who underwent myocardial revascularization from 2003 to 2004 in the Heart Institute of Pernambuco were studied.

Each patient was assessed as for the presence or absence of the 17 risk factors established by the EuroSCORE, respecting the definition of each of them and attributing the correct score (Table 1). Depending on the final score, each patient was placed in one of the three risk groups (Table2), and the occurrence of death was reported. From the 759 patients, seven were excluded because of the absence of information on some of the factors involved in the calculation of the EuroSCORE. To evaluate the calibration and the accuracy of the EuroSCORE, an adjustment in a logistic regression model of operative mortality (response variable) was made to the EuroSCORE obtained (explanatory variable). The calibration of the model was measured by comparing both the observed and expected mortality, applying the Hosmer-Lemeshow Test of Goodness of Fit [11-13]. The accuracy, that is, the capacity of the model to discriminate the patients who died and the ones who survived was assessed through the Statistics-c logistic model. The Statistics-c logistic model is a measurement of the accuracy of binary classifications. It is obtained by forming pairs of patients, where in each pair, just one of the components has a result of interest. In this study, the result of interest was the death of the patient. For any given pair, the predictions obtained by the logistic model are considered to agree with the result, when the patient who died had a higher predicted probability of dying than the surviving patient. Statistics-c is the proportion of predictions in agreement. Its values vary from 0.5 to 1.0 [11,12]. The higher the value of Statistics-c, the greater is the accuracy or the discriminating power of

the model. The Statistics-c is sometimes termed the area under a ROC (Receiver Operating Characteristic) curve, but the values are not always in agreement. Some consider the Statistics-c a generalization of the ROC curve [11].

RESULTS

Of the 752 studied patients, 503 (66.9%) were male and 249 (33.1%) were female. The ages ranged from 27 to 88 years with a mean of 62.6 (± 10.3 years). Approximately 53% of the patients were 63 years old or older (median age). Among these patients, 52% were diabetics, 15.6% were smokers and 74.2% were hypertensive. The determination of the Body Mass Index (BMI) was made in 740 patients, showing that 63% were overweight or obese (BMI > 25.0). Table 3 presents the prevalences of risk factors involved in

Table 1. Risk factors, definitions and score

	Definitions	Score
Patients-related factors		
Age	For 5 years or fraction > 60 years	1
Sex	Female	1
Chronic pulmonary disease	Long term use of bronchodilators or steroids	1
Extracardiac arteriopathy	Any of the following: claudication, carotid occlusion or stenosis >50%, prior or planned intervention on the abdominal aorta, peripheral arteries or carotids	2
Neurological dysfunction	Disease affecting walking or day-to-day activities	2
Previous Cardiac Surgery	Requiring opening of the pericardium	3
Serum creatinine	> 2.3 mg in preoperative	2
Active endocarditis	Patient still on antibiotic treatment for endocarditis at time of surgery	3
Critical preoperative state	Any of the following: ventricular tachycardia / fibrillation or aborted sudden death, preoperative cardiac massage, preoperative ventilation before arriving in the surgical room, preoperative inotropic support or intra-aortic balloon pump, preoperative Acute Renal Failure (<10mL/hr)	3
Cardiac-related factors		
Unstable angina		2
	Angina at rest requiring nitrates until arrival in anesthesia room	
Left Ventricle Dysfunction		1
	LVEF 30-50%	3
Recent myocardial infarction	LVEF < 30%	2
Pulmonary hypertension	< 90 days	2
	Systolic pulmonary artery pressure >60mmHg	
Operation-related factors		
Emergency		2
Other surgeries than myocardial revascularization	Operation before beginning of next working day	2
Surgery on thoracic aorta	Another cardiac surgery or in association to myocardial revascularization	3
Post infarct septal rupture	For ascending aorta, aortic arc or descending aorta	4

Table 2. Mortality risk groups of EuroSCORE

Group	Score
Low risk	0–2
Medium risk	3–5
High risk	>6

the calculation of the EuroSCORE. The prevalences of these risk factors in patients of the EuroSCORE database [9] and STS database [11] are also presented in this table just for comparison purposes.

Table 4 presents the predicted and the observed mortality, according to the groups defined by the Hosmer-Lemeshow test. The predicted mortality by the EuroSCORE can be considered very close to the observed mortality as the p-value in the Hosmer-Lemeshow test was 0.663, indicating a good adjustment or good calibration of the model.

The accuracy or the predictive ability of the EuroSCORE, estimated by the Statistics-c logistic model, was 69.9% (95% Confidence interval: 69% - 70.8%).

The hospital mortality in this series of 752 patients submitted to myocardial revascularization was 1.7% (13 cases). There were two deaths (0.87%) among the 231 patients ranked in the low-risk group, one death (0.37%) in the medium-risk group (n=268) and 10 deaths (3.95%) among the 253 patients in the high-risk group. These results are presented in Table 5, alongside the percentage of deaths predicted by the adjusted model for each EuroSCORE risk group. The inconsistencies between the percentages of the predicted and observed deaths were not statistically significant, according to the results of the qui-square test (p=0.624).

Table 3. Prevalence of risk factors in the patients of this study, of EuroSCORE and of STS

Risk factors	Study (n = 752)	EuroSCORE (n = 19030)	STS (n = 188 912)
Age:			
Mean	62.6	62.5	64.6
< 60 years	38.0	33.2	30.1
60 - 64 years	17.6	17.8	14.1
65 - 69 years	17.0	20.7	18.4
70 - 74 years	14.4	17.9	18.3
75 or + years	13.0	9.6	19.1
Female	33.1	27.8	30.9
Chronic pulmonary disease	9.7	3.9	15.4
Extracardiac arteriopathy	13.3	11.3	19.0
Neurological dysfunction	6.9	1.4	6.3
Previous cardiac surgery	6.5	7.3	11.7
Serum creatinine > 2,3	1.0	1.8	2.1
Active endocarditis	-	1.0	0.4
Critical preoperative state	1.4	4.1	9.0
Unstable angina	39.4	8.0	21.7
Ejection fraction: 30 - 50%	22.1	25.6	37.8
Ejection fraction: < 30%	4.1	5.8	5.2
Recent myocardial infarct	15.0	9.7	20.9
Pulmonary hypertension	-	2.0	5.7
Emergency	2.9	4.9	8.6
Associated procedure	5.3	36.4	18.8
Thoracic aortic surgery	0.5	2.4	0.9
Post infarct septal rupture	0.8	0.2	0.2

Table 4. Observed and predicted mortality using EuroSCORE as a predictive variable at the groups defined by Hosmer-Lemeshow test.

		Discharge condition			
		Death		Survival	
Groups	Number of patients	Observed	Expected	Observed	Expected
1	76	1	0.3	75	75.7
2	73	1	0.4	72	72.6
3	82	0	0.6	82	81.4
4	92	0	0.8	92	91.1
5	102	1	1.1	101	100.8
6	74	0	1.1	74	72.9
7	78	2	1.4	76	76.6
8	90	2	2.3	88	87.7
9	85	6	5.0	79	80.0

Table 5. Comparison of the percentages of observed and predicted deaths at each risk group of the EuroSCORE.

Risk group	Number of cases	Observed deaths (%)	Predicted deaths (%)	P value*
Low-risk (0-2)	231	0.87	0.57	0.624
Medium-risk (3-5)	268	0.37	1.13	
High-risk (>6)	253	3.95	3.42	

*Teste qui-quadrado

DISCUSSION

Stratification of risk provides an estimation of the operative risk in certain individuals and has great importance in retrospective analyses of surgical results, providing a comparison, not only among institutions, but also among individual surgeons and making quality control in the daily clinical practice possible [14,15]. Several score systems have been developed to predict the hospital mortality in heart surgery, especially in coronary artery surgery [1-7]. Since its introduction, the EuroSCORE has been widely accepted all over the world and it has been used as a risk predictor of morbimortality in non-European populations [11-16], but it has not been applied to Brazilians before. The EuroSCORE is a cumulative system in which each of the 17 risk factors receives a number of points that are added together. The final sum provides a score used to place a patient in one of three risk groups: low-risk (score 0-2), medium-risk (score 3-5) and high-risk (score >6).

The EuroSCORE has been applied in North America population and compared to the Society of Thoracic Surgeons registration database, which has already been used as a surgical risk predictor for several years. Despite the demographic differences, the EuroSCORE has proven to be effective to both populations [11].

The EuroSCORE has also been used with high precision to identify groups of patients undergoing cardiac surgery who present lower probabilities of presenting with non-fatal complications [17]. Besides, the modification of the strategy in coronary surgery (with or without cardiopulmonary bypass) in patients with EuroSCORE ≥ 6 has shown that a less aggressive approach may reduce the immediate morbimortality [18]. This system was applied to a group of 752 patients submitted to myocardial revascularization at the Heart Institute of Pernambuco, from 2003 to 2004. It was possible to identify retrospectively, in each patient, the presence or absence of 17 risk factors established by the EuroSCORE, enabling their allocation to three different

groups of risk. The analysis did not show statistically significant differences when comparing the predicted and observed mortality in each risk group. Despite the accuracy of the model, estimated at 69.9% being lower than those obtained in six European countries [15], the EuroSCORE has shown to be a simple and objective index and an acceptable predictor of operative mortality in patients undergoing myocardial revascularization at the Heart Institute of Pernambuco.

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