

# EuroSCORE and the patients undergoing coronary bypass surgery at Santa Casa de São Paulo

*EuroSCORE e os pacientes submetidos a revascularização do miocárdio na Santa Casa de São Paulo*

Valquíria Pelisser CAMPAGNUCCI<sup>1</sup>, Ana Maria Rocha Pinto e SILVA<sup>2</sup>, Wilson Lopes PEREIRA<sup>3</sup>, Eduardo Gregório CHAMLIAN<sup>4</sup>, Sylvio Matheus de Aquino GANDRA<sup>5</sup>, Luis Antonio RIVETTI<sup>6</sup>

RBCCV 44205-983

## Abstract

**Objective:** The aim of this study was to assess the performance of the European System of Cardiac Operation Risk Evaluation (EuroSCORE) model to predict mortality of patients undergoing coronary artery bypass surgery in the Cardiovascular Surgery Division of Santa Casa de São Paulo Medical School.

**Methods:** From May 2005 to November 2006, 100 consecutive patients undergoing coronary artery bypass surgery were retrospectively analyzed. The records of these patients were reviewed in order to retrieve the variables included in the EuroSCORE method. The correlation of predicted and observed mortality was compared. Statistical

analysis was performed using the chi-square test for univariate analysis and the Hosmer-Lemeshow test for logistic regression.

**Results:** Hospital mortality was 5%. The EuroSCORE univariate analysis findings were as follows: score 0-2 predicted mortality 0.40%, observed 0.00%; score 3-5 predicted mortality 1.45%, observed 0.00%; score greater than 6 predicted mortality 3.15%, observed 7.94%. In spite of these differences the p-value was 0.213 demonstrating no statistical significance. The p-value for the Hosmer-Lemeshow test was < 0.001 indicating poor calibration of the model for this sample.

**Conclusion:** The EuroSCORE model is a simple,

1. Assistant professor of the Heart Surgery Division
2. Adjunct professor; Assistant of the Heart Surgery Division
3. Master in Heart Surgery; Assistant of the Heart Surgery Division
4. Instructor professor; Assistant of the Heart Surgery Division
5. Adjunct professor; Assistant of the Heart Surgery Division
6. Adjunct professor; Head of the Heart Surgery Division

Work carried out at the Central Hospital da Irmandade de Misericórdia da Santa Casa de São Paulo, Surgery Department, Cardiovascular Surgery Division of the Santa Casa de São Paulo Medical School, São Paulo, Brazil

Presented in the 10<sup>th</sup> Congress of the Cardiovascular Surgery Society of Sao Paulo State in Águas de São Pedro on 10<sup>th</sup> November 2007

Correspondence address:

Valquíria Pelisser Campagnucci. Rua Jacarandá, 105. Condomínio Melville. Alphaville Santana de Parnaíba, SP, Brazil. CEP: 06543-275  
E-mail: valpelisser@terra.com.br

Article received on November 28<sup>th</sup>, 2007

Article accepted on February, 18<sup>th</sup>, 2008

objective system to estimate hospital mortality. However, to validate the logistic regression analysis, hundreds of patients are necessary, which limits its widespread application.

**Descriptors:** Coronary artery bypass surgery/mortality. Risk assessment. Survival analysis. Severity of illness index.

#### Resumo

**Objetivo:** Avaliar o perfil atual do paciente submetido a revascularização do miocárdio na Disciplina de Cirurgia Cardíaca da Faculdade de Ciências Médicas da Santa Casa de São Paulo, verificar o risco de mortalidade esperada neste grupo, por meio da aplicação do Sistema Europeu de Risco em Operações Cardíacas (EuroSCORE), e confrontá-lo com a mortalidade observada.

**Métodos:** Analisamos 100 pacientes consecutivos submetidos a revascularização do miocárdio, de maio de 2005 a novembro de 2006. Identificamos os fatores predisponentes à coronariopatia e analisamos os critérios de risco de mortalidade pelo EuroSCORE. Comparamos as taxas de mortalidade esperadas com as observadas na amostra.

Aplicamos o teste do qui-quadrado para análise univariada e o teste de Hosmer-Lemeshow para ajuste do modelo de regressão logística.

**Resultados:** A mortalidade hospitalar foi 5,0%. Na análise univariada, para escore 0-2 a mortalidade prevista pelo EuroSCORE foi de 0,40% e a encontrada 0%. Para o escore 3-5, a mortalidade prevista foi de 1,45% e a encontrada 0%. Para escore >6, a mortalidade prevista foi de 3,15% e a encontrada 7,94%. As discrepâncias entre as porcentagens observadas e previstas não foram estatisticamente significantes ( $p = 0,213$ ). O valor-p do teste de Hosmer-Lemeshow foi igual a  $< 0,001$ , indicando um ajuste ruim ou má calibração do modelo para o número de indivíduos na amostra atual. **Conclusão:** O EuroSCORE é um modelo preditor simples e objetivo de mortalidade operatória. Entretanto, para validação da análise de regressão logística, são necessárias centenas de indivíduos, o que limita a universalização de sua aplicabilidade.

**Descritores:** Revascularização miocárdica/mortalidade. Avaliação de risco. Análise de sobrevivência. Índice de gravidade de doença.

## INTRODUCTION

The diversification in the possibilities of treatment of cardiac ischemic disease, the perfecting of operative strategies and the frequent advances in the areas of technology applied to medicine have caused a change in the profile of patients submitted to coronary artery bypass grafting (CABG). Additionally, with the aging of the population, a considerable number of elderly patients are referred for surgical treatment [1-3]. Thus, this therapeutic option has been offered to an increasing number of the most varied patients.

Mortality rate is routinely applied as an indicator of the quality of medical services [4]. Frequently, this indicator is utilized in a general form without knowing the exact profile of the studied population. In an effort to better stratify the risk for death in heart surgery, analysis models were developed with an aim to better characterize factors that influence the results. The European System of Cardiac Operation Risk Evaluation (EuroSCORE) is one of them [4-6]. This model, with univariate statistical analysis and logistic regression, demonstrated accuracy even when applied to non-European populations [7-9]. Based on data collected from 128 centers of eight European countries, this system evaluated 68 pre-operative and 29 operative risk factors that may influence hospital mortality. A total of 17 real risk factors were identified and for each one a score

was attributed in a univariate analysis, thereby classifying the patients in three groups according to the obtained risk (low, medium or high). In the analysis by logistic regression a weight of the same factors is attributed. This is an easy-to-use model accessible via the web which is popularizing its use.

The aim of this work was to evaluate the current clinical profile of patients submitted to CABG in the Cardiovascular Surgery Division of Santa Casa de São Paulo Medical School, to check the expected risk of death in this group of patients by applying the EuroSCORE and compare this with the observed deaths.

## METHODS

The basis to carry out this research was a retrospective analysis of data. Over a period of 18 months between May 2005 and November 2006, 553 patients were submitted to heart surgery in the Central Hospital of the Santa Casa de São Paulo Medical School. Among these patients, 103 were submitted to CABG. A total of 100 patients, whose hospital records contained all the information necessary for an analysis of the criteria of operative mortality risk according to the 17 items included in the EuroSCORE (Table 1), were selected. Patients with incomplete data were excluded. In Table 2 the characteristics of our patients are presented classified in their respective groups of risk. The expected

mortality rates, by applying the EuroSCORE, were compared with the observed deaths in the sample. Statistical analysis of the sample was achieved using the chi-squared test for univariate analysis and the Hosmer-Lemeshow test to calibrate and adjust the logistic regression of the EuroSCORE to the sample. The confidentiality of the data obtained from the patients' records were guaranteed and utilized exclusively for the current study which was approved by the Research Ethics Committee of the institution (protocol number 011/08).

## RESULTS

Of the 100 patients, 60 were male. The patients' ages

varied from 26 to 89 years old (mean = 61.3 years and SD = 11.7 years) with 45% of patients having ages equal to or greater than 65 years old. Seventy-six patients suffered from systemic arterial hypertension, 47 from dyslipidemia, 40 were smokers, 34 diabetics and 14 were obese (Body Mass Index > 35). Only 4 reported coronary artery disease in the family. Thirty patients underwent elective surgeries and 70, due to instable angina, post-infarction angina or critical coronary artery lesions, were submitted to urgent surgery. Eighteen individuals had lesions of the left main coronary artery. The prevalences of risk factors of the study sample and of the EuroSCORE study are illustrated in Table 2. Eight patients were considered low risk (Score 0-2), 29 medium risk (Score 3-5) and 63 high risk (Score > 6). Fifty-

Table 1. Risk factors, definitions and scores

Factors	Definition	Score
<b>Related to patient</b>		
Age	For 5 years or fraction > 60 years	1
Gender	Female	1
Chronic pulmonary disease	Prolonged use of de bronchodilators or steroids	1
Extracardiac artery disease	Claudication or obstruction > 50% of carotid arteries or previous or planned intervention of the abdominal aorta, carotid arteries or peripheral arteries	2
Neurological dysfunction	Disease affecting walking or daily activities	2
Previous heart surgery	Requiring opening of the pericardium	3
Serum creatinine	>2.3 mg in the pre-operative period	2
Active endocarditis	Using antibiotics at time of surgery	3
Critical preoperative state	Any of the following: ventricular tachycardia or fibrillation or aborted sudden death, pre-operative heart massage, pre-operative ventilation before arriving in the surgery room, pre-operative inotropic support, intra-aortic balloon or pre-operative acute renal failure (<10 mL/h)	3
<b>Related to the heart</b>		
Instable angina	Resting angina requiring the use of nitrates before arrival in the anesthesia room	2
Left ventricle dysfunction	EF 30 - 50%	1
	EF < 30%	3
Recent myocardial infarction	< 90 days	2
Pulmonary hypertension	Systolic pressure of the pulmonary artery > 60mmHg	2
<b>Related to the procedure</b>		
Emergency	Performed before the following day's shift	2
Surgeries associated to CABG	Another heart procedure at the same time as CABG	2
Surgery of the thoracic aorta	Ascending aorta, aortic arch or descending aorta	3
Post-infarction ventricular septal defect		4

four patients were operated on employing cardiopulmonary bypasses (CPB). Of these, 25 were classified as high-risk patients. Hospital mortality, observed only in high-risk patients submitted to CPB, was 5%.

Table 3 presents differences in the predicted and observed deaths according to the groups, as defined by the Hosmer-Lemeshow test. The p-value for this test was < 0.001 indicating bad adjustment or bad calibration of the model for the current sample size, despite of the accuracy, as estimated by c-statistics of the logistic method, being very high (94.7%). Table 4 shows that the divergences in the percentages of predicted and observed deaths were not statistically different according to the chi-squared test and univariate analysis (p-value = 0.213).

## DISCUSSION

The current clinical profile of patients submitted to heart surgery puts into question

Table 2. Prevalence of risk factors in the patients of EuroSCORE and in the current study

Risk factor	EuroSCORE (n = 19.030)	Current study (n = 100)
Age:		
Mean	62.5	61.3 (SD = 11.7)
< 60 years	33.2	42.0
60 - 64 years	17.8	13.0
65 - 69 years	20.7	19.0
70 - 74 years	17.9	10.0
75 or + years	9.6	16.0
Women	27.8	40.0
Chronic pulmonary disease	3.9	15.0
Extracardiac artery disease	11.3	12.0
Neurological dysfunction	1.4	7.0
Previous heart surgery	7.3	1.0
Creatinine > 2.3	1.8	8.0
Active endocarditis	1.0	0.0
Critical preoperative state	4.1	14.0
Unstable angina	8.0	70.0
Ejection fraction: 30 - 50%	25.6	25.0
Ejection fraction: < 30%	5.8	43.0
Recent myocardial infarction	9.7	48.0
Pulmonary hypertension	2.0	0.0
Emergency	4.9	0.0
Associated procedure	36.4	0.0
Surgery of the thoracic aorta	2.4	0.0
Post-infarction ventricular septal defect	0.2	0.0

Table 3. Observed mortality and predicted mortality employing the EuroSCORE as predicting variable in the groups defined by the Hosmer-Lemeshow test

Groups	N° of patients	Condition at hospital release			
		Death		Surviving	
		Observed	Expected	Observed	Expected
1	11	3	0.16	8	10.84
2	11	0	0.38	11	10.62
3	6	0	0.32	6	5.68
4	10	1	0.71	9	9.29
5	10	1	0.96	9	9.04
6	15	0	1.91	15	13.09
7	8	0	1.34	8	6.66
8	8	0	1.74	8	6.26
9	10	0	2.77	10	7.23
10	11	0	4.80	11	6.20

the incidence of operative or hospital deaths as reliable indicators and sufficient to evaluate the quality of services. Without adjustments, taking into consideration associated risk factors, the conclusions might be incorrect, mainly when applied to a specialty in which, it is well known, that the most critical patients are those that benefit most from surgical as opposed to conservative clinical treatment [5,10,11].

Different systems of risk stratification have been utilized over the two last decades with the objective of: predicting mortality, evaluating therapeutic trends and analyzing cost-benefits [5,12]. Additionally, the application of a scoring system provides information to patients and their families in respect to the risk that individual patients will be submitted. This resource may be a facilitating tool in the communication and in the comprehension of risks.

Among the different studies to stratify operative mortality risk, the EuroSCORE has proved to be accurate, even when applied to non-European populations [7-9]. It is easy to use at the bedside and allows an analysis very close to the results, particularly in surgeries of the coronary arteries.

We retrospectively applied the EuroSCORE to analyze operative death in 100 consecutive patients operated in Santa Casa de Sao Paulo, a tertiary hospital that attends a large number of urgent cases and emergencies in its central emergency room. The service attends approximately 12,000 patients monthly. Consequently, 70% of the patients in our sample are referred by the emergency unit and present with unstable or post-infarction angina or with severe coronary artery lesions and are submitted to urgent surgeries, a great difference to the patients enrolled in the EuroSCORE trial.

Table 4: Comparison of the percentages of observed deaths and those predicted in each risk group of the EuroSCORE.

Risk group	N° of cases	Observed deaths (%)	Predicted deaths (%)	p-value*
Low risk (0-2)	8	0	0.40	
Medium risk (3-5)	29	0	1.45	0.213
High risk (>6)	63	7.94	3.15	

\*chi-squared

Many risk factors were observed in our sample including chronic pulmonary disease, neurological dysfunction, renal failure and pre-operative critical states as well as factors related to the heart such as instable angina, ventricular dysfunction with ejection fraction < 30% and an incidence of 48% of recent myocardial infarction.

The overall operative mortality was 5% which only involved high-risk patients. This corresponds to a mortality rate of 7.94% for this group, a higher percentage than that predicted by the EuroSCORE. In the low- and medium-risk groups there were no deaths, which is also different from the rates expected by applying the EuroSCORE. Other authors have reported similar results, where the death of low-risk patients was overestimated and of high-risk patients underestimated [13,14].

In respect to the underestimated mortality rate, the difference in this study, may be attributed to the characteristics of our service, notably that it attends many emergencies. This suggests a bias in the application of this risk score in institutions with this characteristic. There are no published reports applying the EuroSCORE to populations with a predominance of emergencies with which the results of this study can be compared. Even so, the discrepancies between the observed and predicted death rates employing univariate analysis were not statistically significant (Table 4).

Another positive characteristic of our service is our experience of CABG without using CPB. There were no deaths among patients who were not submitted to CPB. As has already been reported by Calafiore et al. [15], this surgical strategy, particularly in high-risk patients, contributes to a reduction in the operative mortality.

We applied the Hosmer-Lemeshow test and verified that, in spite of the high accuracy (94.7%), a p-value < 0.001 was attained indicating bad calibration of the sample for the logistic regression analysis. A larger number of patients (hundreds) are necessary to better adjust the applicability of this test. There is, therefore, a limitation in the application of this score in its logistic regression analysis as many services do not treat this number of patients. In the original work [5], for example, Germany contributed 4779 patients

from 23 centers (average of 207 patients per center) and Spain 2444 from 25 centers (average of 97 patients per center), while the sample from Switzerland was 111 patients from a single center, thus similar to the number in our study. The mean number of patients enrolled in the original study was 148 patients per center, which is less than the necessary to validate the logistic regression analysis.

#### CONCLUSION

The EuroSCORE is a simple and objective model to predict operative death. However, to validate the logistic regression analysis, hundreds of patients are necessary, thus limiting its application when this number is not available.

#### REFERENCES

1. Suojaranta-Ylinen RT, Kuitunen AH, Kukkonen SI, Vento AE, Salminen US. Risk evaluation of cardiac surgery in octogenarians. J Cardiothorac Vasc Anesth. 2006;20(4):526-30.
2. Siddiqui FJ, Sami SA, Sarwar G, Shahabuddin S, Ahmed B. Coronary artery bypass surgery in the elderly: experience of tertiary care hospital. Asian Cardiovasc Thorac Ann. 2006;14(6):479-84.
3. Mortasawi A, Arnrich B, Walter J, Frerichs I, Rosendahl U, Ennker J. Impact of age on the results of coronary artery bypass grafting. Asian Cardiovasc Thorac Ann. 2004;12(4):324-9.

4. Nilsson J, Algotsson L, Höglund P, Lühns C, Brandt J. Early mortality in coronary bypass surgery: the EuroSCORE versus The Society of Thoracic Surgeons risk algorithm. *Ann Thorac Surg.* 2004;77(4):1235-9.
5. Roques F, Nashef SA, Michel P, Gauducheau E, de Vincentiis C, Baudet E, et al. Risk factors and outcome in European cardiac surgery: analysis of the EuroSCORE multinational database of 19030 patients. *Eur J Cardiothorac Surg.* 1999;15(6):816-22.
6. Nashef SA, Roques F, Michel P, Gauducheau E, Lemeshow S, Salamon R. European system for cardiac operative risk evaluation (EuroSCORE). *Eur J Cardiothorac Surg.* 1999;16(1):9-13.
7. Nashef SA, Roques F, Hammill BG, Peterson ED, Michel P, Grover FL, et al. Validation of European System for Cardiac Operative Risk Evaluation (EuroSCORE) in North American cardiac surgery. *Eur J Cardiothorac Surg.* 2002;22(1):101-5.
8. Yap CH, Reid C, Yip M, Rowland MA, Mohajeri M, Skillington PD, et al. Validation of the EuroSCORE model in Australia. *Eur J Cardiothorac Surg.* 2006;29(4):441-6.
9. Moraes F, Duarte C, Cardoso E, Tenório E, Pereira V, Lampreia D, et al. Avaliação do EuroSCORE como preditor de mortalidade em cirurgia de revascularização miocárdica no Instituto do Coração de Pernambuco. *Rev Bras Cir Cardiovasc* 2006;21(1):29-34.
10. Biancari F, Kangasniemi OP, Luukkonen J, Vuorisalo S, Satta J, Pokela R, et al. EuroSCORE predicts immediate and late outcome after coronary artery bypass surgery. *Ann Thorac Surg.* 2006;82(1):57-61.
11. Mark DB. Implications of cost in treatment selection for patients with coronary heart disease. *Ann Thorac Surg.* 1996;61(2 Suppl):S12-5.
12. Parsonnet V, Dean D, Bernstein AD. A method of uniform stratification of risk for evaluating the results of surgery in acquired adult heart disease. *Circulation.* 1989;79(6 Pt 2):I3-12.
13. Gogbashian A, Sedrakyan A, Treasure T. EuroSCORE: a systematic review of international performance. *Eur J Cardiothorac Surg.* 2004;25(5):695-700.
14. Roques F, Michel P, Goldstone AR, Nashef SA. The logistic EuroSCORE. *Eur Heart J.* 2003;24(9):881-2.
15. Calafiore AM, Di Mauro M, Canosa C, Di Giammarco G, Iaco AL, Contini M. Early and late outcome of myocardial revascularization with and without cardiopulmonary bypass in high risk patients (EuroSCORE  $\geq$  6). *Eur J Cardiothorac Surg.* 2003;23(3):360-7.