Original Article

COMPARISON OF TWO RISK STRATIFICATION MODELS IN ELECTIVE CORONARY ARTERY BYPASS PATIENTS

Rosane Maria Nery[1], Rosa Cecília Pietrobon[2], Mahmud Ismail Mahmud[3], Maurice Zanini[4], Juarez Neuhaus Barbisan[5*]

Study conducted at the Instituto de Cardiologia do Rio Grande do Sul/ Fundação Universitária de Cardiologia - FUC, Porto Alegre, RS, Brazil

ABSTRACT

Objective. To compare the Cleveland Clinical Score and EuroSCORE when evaluating patients submitted to elective CABGS in Rio Grande do Sul, RS, Brazil.

Methods. This was a cohort study of 202 patients given CABGS between January 2006 and March 2007. Surgical risk was categorized according to the Cleveland Clinic Score and the EuroSCORE as low, medium or high. The incidence of deaths was measured over a 60-day period.

Results. The mean age of patients was 62±10 years and 134 (66%) of them were men. A correlation was observed between the scores for classifying patients into different levels of risk. According to the Cleveland Clinic score and the EuroSCORE, respectively, patients were categorized as follows: 142(70.3%) and 155(76.7%) low risk patients, 56(27.7%) and 43(21.3) intermediate risk patients and 4(2%) and 4(2%) high risk patients; with a Kaplan correlation coefficient of 0.432; p0.001. Thirteen (13, 6.4%) patients died during the first 60 days after surgery. There was a correlation between greater incidence of death and higher risk categories for both the Cleveland Clinic score and the EuroSCORE. Deaths occurred in the Cleveland and EuroSCORE risk groups, respectively, as follows: 6 (4.4%) and 7 (4.5%) in the low risk group; 5 (8.9%) and 5 (11.6%) in the intermediate risk group and 2 (50%) 3 1(25%) in the high risk group. Observed sensitivity for surgical mortality prediction was 72.5% and 66.5% for the Cleveland score and EuroSCORE respectively.

Conclusion. The Cleveland Clinic and EuroSCORE surgical risk prediction instruments are both moderately effective for predicting mortality among elective CABGS patients.

Key words: Risk. Myocardial Revascularization. Coronary Artery Bypass, Surgery.

***Correspondence:**
Av. Princesa Isabel, 370 - Santana
Porto Alegre - RS, Brazil
CEP: 90620-000

Introduction

Coronary artery bypass surgery (CABGS) is a surgical procedure that is widely studied because of the great clinical interest and because its outcomes are very easily defined. Surgical risk assessment is an important part of preoperative preparation for heart surgery. It gives patients and their families an idea of the real risk of complications and death[1]. It is indispensable for the medical team when choosing the procedure, planning postoperative care, predicting prognosis and considering issues of cost against benefit[1-4]. The Cleveland Clinical Score was first formulated in 1986 at the Cleveland Clinic Foundation in order to assess the risk of surgery in patients with indications for coronary artery surgery. They identified 13 risk factors that constituted a model that was capable of stratifying patients into three different levels of risk of death from coronary artery bypass graft surgery: low risk (score < 3), intermediate risk (score 3 to 6) or high risk (score > 6)[4]. The EuroSCORE is one of the most up-to-date risk stratification models. It was developed on the basis of data collected from 130 centers in eight different European countries and is designed to predict mortality both for patients who will undergo CABGS and also for heart valve surgery patients[2]. Elective surgery was not therefore considered when comparing the scores. The objective of this study is to compare the applicability of two risk scores, the Cleveland Clinical Score and the EuroSCORE, in patients with stable coronary artery disease (CAD) scheduled to undergo elective CABGS in the Brazilian state of Rio Grande do Sul.

1- Mestrado em Ciências da Saúde e Cardiologia; educadora física e doutoranda do programa de pós-graduação da Universidade Federal do Rio Grande do Sul – UFRGS, Porto Alegre, RS
2- Mestrado em Ciências da Saúde, Cardiologia; psicóloga
3- Mestre em Epidemiologia e fisioterapeuta do Hospital de Clínicas de Porto Alegre – HCPA, Porto Alegre, RS
4- Graduação em Educação Física; educadora física da Universidade Federal do Rio Grande do Sul – UFRGS, Porto Alegre, RS
5- Doutor em Medicina – Cardiologia e chefe do serviço de *Tilt Test* do Instituto de Cardiologia do Rio Grande do Sul RS/ Fundação Universitária de Cardiologia-FUC, Porto Alegre, RS

Methods

This was a prospective cohort study that assessed 215 consecutive, adult, non-hospitalized patients of both sexes who were admitted electively to undergo CABGS with grafts from the saphenous vein and/or mammary artery. These patients were recruited at three public hospitals in Rio Grande do Sul between January of 2006 and March of 2007. Patients were excluded if they were operated on under emergency conditions, had acute coronary syndrome or underwent other surgical procedures at the same time. The primary outcome for this study was mortality, defined as death from all causes while in hospital or within 60 days of hospital discharge.

Ethical considerations

The study was approved by the Ethics Committees and Scientific Committees at the Instituto de Cardiologia do Rio Grande do Sul, the Hospital de Clínicas de Porto Alegre and the Santa Casa de Misericórdia de Porto Alegre. Free and informed consent was obtained from all patients.

Instruments

A structured questionnaire was administered and data were collected on demographic, anthropometric and clinical factors. Each patient was assessed for presence or absence of the 13 risk factors defined by the Cleveland Clinical Score and the 17 risk factors defined by the EuroSCORE, respecting the definitions of each one and attributing the correct scores to them. Patients were stratified into three risk groups and followed-up in outpatient consultations at 30 and 60 days, in order to check for complications and deaths.

Sample

In order to detect a correlation with r greater than 0.3, with statistical power of 90% and a 5% significance level, we calculated that the minimum sample size would be 113 patients. We enrolled 202 patients on this study, who were part of the sample for a study published by Nery and Barbisan[5].

Statistical analysis

The data collected were analyzed using the program Statistical Package for the Social Sciences (SPSS version 15.0). Categorical variables are given as absolute frequencies and percentages. Continuous variables with normal distribution are given as means and standard deviations and variables without normal distribution are shown as median and interquartile amplitude (IQ). The level of agreement between scores was assessed using the Intraclass Correlation Coefficient. Predicted mortality (in percentage terms) was defined as the sum of the mortality scores according to each model, divided by the number of patients assessed. The observed mortality was the actual number of deaths divided by the corresponding number of patients. The outcome of interest in this study was death. For any given pair, the predictions of the logistic model are defined as agreeing with the outcome when the patient who died had a greater predicted probability of death than the survivor. The c-statistic is the proportion of predictions agreeing with the outcome. Possible values are in the range of 0.5 to 1. 6 The greater the value of the c-statistic, the greater the model's accuracy or discriminatory power. The c-statistic is also known as the area under the curve of the receiver operating characteristic (ROC AUC).

Results

Thirteen of the 215 patients interviewed at three public hospitals in Rio Grande do Sul were excluded because they were not eligible for surgery. Table 1 lists demographic, anthropometric and clinical variables for the patients. There was a greater proportion of men and a high number of smokers. Preoperative physical activity was defined as any type of physical activity lasting at least 30 minutes, three times a week up to 2 weeks before surgery. The patients who underwent CABGS were classified into one of three risk bands by the Cleveland Clinic and EuroSCORE scales. It was observed that there was moderate agreement between the two scores in terms of classifying patients into different risk bands, with agreement being most evident among high risk patients. Kappa correlation = 0.432; $P<0.001$. Cleveland score: low risk 142 patients (70.3%), intermediate risk 56 patients (27.7%) high risk 4 patients (2%). EuroSCORE: low risk 155 patients (76.7%), intermediate risk 43 patients (21.3%) and high risk 4 patients (2%). Both scales differentiated significantly between the scores attributed to patients who died and those who survived. Analyzing the medians and interquartile amplitudes, according to the Cleveland score patients who died scored up to two points in the 25% quartile and up to five points in the 75% quintile, with a median of three points ($P=0.004$). The same occurred with the EuroSCORE, by which the patients who died scored up to one point in the 25% quintile and four points in the 75% quintile with a median of two points ($P=0.039$). Table 2 relates the number of patients classified into each category according to the Cleveland score and the EuroSCORE to actual surgical mortality. According to the Cleveland score, 142 patients were low risk, 56 were intermediate risk and 4 were high risk. According to the EuroSCORE, there were 155 low risk, 43 intermediate risk and 4 high risk patients. A correlation was observed between increase in the incidence of death and increase in the category of risk for both scores. Figure 1 illustrates the sensitivity and specificity of the Cleveland score and the EuroSCORE for predicting mortality, plotted on a ROC curve. The comparison between the two scores is slightly favorable to the Cleveland Clinic score. We observed 72.5% and 66.5% sensitivity for predicting surgical mortality for the Cleveland score and EuroSCORE, respectively.

Discussion

NOur study shows the applicability of both scores for predicting mortality in patients undergoing elective CABGS in Rio Grande do Sul. Similarity between the two was moderate and the Cleveland score proved a little more sensitive with respect to the outcome death. In contrast, a study conducted by Moraes et al. with a group of 752 patients who underwent CABGS at the Instituto do Coração de Pernambuco in 2003

Table 1 - Demographic, anthropometric and clinical characteristics of patients given elective coronary artery bypass graft surgery

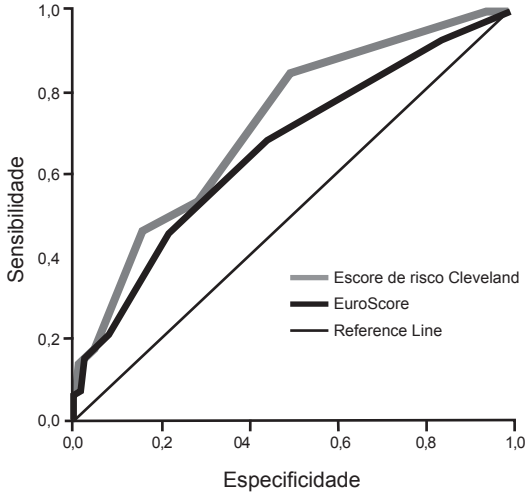
Variables	202 patients n(%) or mean ± SD
Sex	
Male	134 (66.3)
Age	61.8 ± 10.3
Educational level (years in education)	7.5 ± 3.7
Body mass index	26.9 ± 4.7
Preoperative physical activity	66 (32.7)
Smoking	129 (63.9)

Table 2 - Incidence of death in Cleveland Clinic score and EuroSCORE risk categories

	Death n (%)	Survival n (%)
Cleveland		
Low	6 (4.4)	136 (95.6)
Intermediate	5 (8.9)	51 (91.1)
High	2 (50)	2 (50)
EuroSCORE		
Low	7 (4.5)	148 (95.5)
Intermediate	5 (11.6)	38 (88.4)
High	1 (25)	3 (75)

and 2004, the EuroSCORE proved to be a simple and objective scale and was a satisfactory predictor of surgical mortality[7]. Andrade et al. assessed the applicability of the EuroSCORE with 840 patients undergoing valve surgery and observed that the score proved to be a satisfactory predictor of surgical mortality and helpful for identifying risk during valve surgery in Pernambuco[8]. There are many differences between countries in terms of the indications for surgery, technical capacity and the characteristics of the patients given CABGS. These differing characteristics can affect the risk stratification performance of different scores. Several different risk stratification models have been validated with the objective of preventing mortality and major cardiac adverse events during and after coronary artery bypass graft surgery (CABGS)[9-16]. The scientific evidence suggests that the Cleveland Clinic score and the EuroSCORE are the most useful for predicting the prognosis of patients given CABGS.

Figure 1 - Sensitivity and specificity of the Cleveland Clinic score and EuroSCORE for predicting mortality among elective CABGS patients



In both cases the variable emergency surgery had the greatest power to predict mortality[17]. Validation of these instruments at different institutions therefore appears to be recommendable. Limitations: the small number of patients enrolled on this study is a result of the fact that this was a secondary objective of a larger project designed to evaluate the influence of physical activity in free time on the prognosis of patients given CABGS, and the sample size was calculated for that study[5]. The sample size would have had to be greater in order to assess the outcome mortality. Another factor that impacts on this outcome is developments in surgical techniques and preoperative and postoperative care, reducing the number of complications and, consequently, of deaths.

Conclusion

The Cleveland Clinic and EuroSCORE surgical risk prediction instruments are effective for predicting mortality among elective CABGS patients.

Conflicts of interest: none

References

1. Bojar R. Manual of perioperative care in cardiac surgery. 3rd ed. Massachusetts: Blackwell Publishing; 1999.
2. Au WK, Sun MP, Lam KT, Cheng LC, Chiu SW, Das SR. Mortality prediction in adult cardiac surgery patients: comparison of two risk stratification models. Hong Kong Med J. 2007;13(4):293-7.
3. Nashef S, Carey F, Charman S. The relationship between predicted and actual cardiac surgical mortality: impact of risk grouping and individual surgeons. Eur J Cardiothorac Surg. 2001;19(6):817-20.
4. Roques F, Nashef S, Michel P, Gauducheau E, de Vincentiis C, Baudet E. 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.

5. Nery R, Barbisan J. Efeito da atividade física de lazer no prognóstico da cirurgia de revascularização do miocárdio. Rev Bras Cir Cardiovasc. 2010;25(1):73-8.
6. OConnor GT, Plume SK, Olmstead EM, Coffin LH, Morton JR, Maloney CT, et al. Multivariate prediction of in-hospital mortality associated with coronary artery bypass graft surgery. Northern New England Cardiovascular Disease Study Group. Circulation. 1992;85(6):2110-8.
7. Moraes F, Duarte C, Cardoso E, Tenório E, Pereira V, Lampreia D. Assessment of the EuroSCORE as a predictor for mortality in myocardial revascularization surgery at the Heart Institute of Pernambuco. Braz J Cardiovasc Surg. 2006;21(1):29-34.
8. Andrade I, Moraes Neto F, Oliveira J, Silva I, Andrade T, Moraes C. Avaliação do EuroSCORE como preditor de mortalidade em cirurgia cardíaca valvar no Instituto do Coração de Pernambuco. Rev Bras Cir Cardiovasc. 2010;25(1):11-8.
9. Bernstein A, Parsonnet V. Bedside estimation of risk as an aid for decision-making in cardiac surgery. Ann Thorac Surg. 2000;69(3):823-8.
10. Edwards FH, Grover FL, Shroyer AL, Schwartz M, Bero J. The Society of Thoracic Surgeons National Cardiac Surgery Database: current risk assessment. Ann Thorac Surg. 1997;63(3):903-8.
11. Grover F, Johnson R, Marshall G, Hammermeister K. Factors predictive of operative mortality among coronary artery bypass subsets. Ann Thorac Surg. 1993;56(6):1296-306.
12. Hannan EL, Kilburn H, Jr., Racz M, Shields E, Chassin MR. Improving the outcomes of coronary artery bypass surgery in New York State. JAMA. 1994;271(10):761-6.
13. Higgins TL, Estafanous FG, Loop FD, Beck GJ, Blum JM, Paranandi L. Stratification of morbidity and mortality outcome by preoperative risk factors in coronary artery bypass patients. A clinical severity score. JAMA. 1992;267(17):2344-8.
14. Higgins TL, Estafanous FG, Loop FD, Beck GJ, Lee JC, Starr NJ, et al. ICU admission score for predicting morbidity and mortality risk after coronary artery bypass grafting. Ann Thorac Surg 1997;64(4):1050-8.
15. Ivanov J, Tu J, Naylor C. Ready-made, recalibrated, or remodeled? Issues in the use of risk indexes for assessing mortality after coronary artery bypass graft surgery. Circulation. 1999;99(16):2098-104.
16. Mozes B, Olmer L, Galai N, Simchen E. A national study of postoperative mortality associated with coronary artery bypass grafting in Israel. ISCAB Consortium. Israel Coronary Artery Bypass Study. Ann Thorac Surg. 1998;66(4):1254-62; discussion 1263.
17. Asimakopoulos G, Al-Ruzzeh S, Ambler G, Omar R, Punjabi P, Amrani M. An evaluation of existing risk stratification models as a tool for comparison of surgical performances for coronary artery bypass grafting between institutions. Eur J Cardiothorac Surg. 2003;23(6):935-41.

Artigo recebido: 20/11/09
Aceito para publicação: 08/07/10