PREDICTIVE VALUE OF EUROSCORE IN PAKISTANI CARDAIC SURGICAL PATIENTS

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ABSTRACT

Objective: To evaluate the predictive value of European System for Cardiac Operative Risk Evaluation (EuroSCORE) of early mortality in Pakistani cardiac surgical population in a single cardiac center.

Study design: A prospective, single institution, observational cohort study.

Place and duration of study: Department of Cardiac Surgery AFIC Rawalpindi from 1st January, 2009 to 31st December 2009.

Patient and Methods: A total of 1064 consecutive adult patients undergoing cardiac surgical intervention at department of adult cardiac surgery from 1st January 2009 to 31st December 2009 were included in the study. The logistic EuroSCORE score was estimated for all the patients and compared with the observed 30 day mortality. The patients were divided into three risk groups on the basis of their EuroSCORE. The Hosmer-Lemeshow goodness-of-fit test was applied to assess the calibration of the EuroSCORE model and the area under the receiver operating characteristic (ROC) curve was measured to analyse the EuroSCORE discriminative power on individual death prediction. Expected mortality was compared to observed or actual mortality. Mortality was defined as death from any cause within 30 days of operation or within the same hospital admission.

Results: The Hosmer-Lemeshow test revealed a good calibration power (p = 0.73) and the area under the ROC curve was 0.753, suggesting a good discriminative power. The predicted mortality was similar to observed mortality in low- and moderate-risk patients but the observed mortality in high-risk patients (18.18%) was very high as compared to predicted mortality (8.14%).

Conclusion: EuroSCORE is a reasonably good relevant predictor of immediate post-operative mortality in low and intermediate risk groups after cardiac surgery in Pakistani population, but is less predictive for high-risk patients.

Keywords: Cardiac Surgery, EuroSCORE, Risk stratification.

INTRODUCTION

Risk stratification in cardiac surgery has assumed special importance in this modern era as it allows scientific analysis of various treatment modalities, helps in improving quality of care and optimal allocation and utilization of resources in a result-oriented and cost-effective manner[1]. As a result of continually improving surgical strategy and the technology which supports it, cardiac surgery is now possible in an increasingly high-risk population[2]. Crude mortality rates have often been used as an indicator of quality of care, but their value is limited without knowledge of the risk profile of the patients[3]. Contemporary scoring systems used for adult cardiac surgical patients are fairly accurate in predicting "mortality"[4].

The European System for Cardiac Operative Risk Evaluation (EuroSCORE) was developed between 1995 and 1999 to provide a simple, additive risk model in European adult cardiac surgery[5] and has gained wide acceptance in Europe and elsewhere. The EuroSCORE model has been developed on European population and has been validated on Japanese[6], Spanish[7] and the North American[8] population. The model has not been validated till date in Pakistan. The purpose of this study was to evaluate the performance of EuroSCORE and its validation on Pakistani patients and help in expanding its scope for our patients as well as comparing the surgical results of our institutions performing cardiac surgery with those of western countries.

PATIENTS AND METHODS

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This prospective, single institution, observational cohort study was conducted in the department of cardiac surgery at AFIC Rawalpindi, from 1st January 2009 to 31st December 2009. After approval from the institution ethics committee, this study was conducted on 1064 consecutive adult patients undergoing cardiac surgery at AFIC. The study involved assessment of 17 risk factors identified in EuroSCORE model through a thorough history, physical examination, investigations and review of the medical records in the preoperative period. Based upon these data, scores were given to each risk factor as guided by the Logistic EuroSCORE calculator (Table-1) and the total score was calculated and recorded as EuroSCORE for that patient.

The patients were followed up in the postoperative period till 30 days following cardiac surgery and all record updated in hospital data base. Based on the EuroSCORE, the patients were categorized as patients with low risk (EuroSCORE 0-2), moderate risk (EuroSCORE 3-5) and high risk (EuroSCORE >6) of in-hospital mortality following cardiac surgery. Expected mortality was compared to observed or actual mortality for each patient. Mortality was defined as death from any cause within 30 days of operation or within the same hospital admission. The primary end point of the study was to record in-hospital mortality after cardiac surgery.

Statistical Analysis

Statistical analysis was performed using SPSS statistical software (SPSS version 17). The model's validation was performed by assessing its calibration power and discriminatory power. Calibration power was assessed by goodness of fit testing using Hosmer-Lemeshow test. A p value > 0.05 indicates that the model fits the data well and therefore accurately predicts mortality. Discriminatory power of a model pertains to its ability to discriminate between patients who died during hospitalization from those who did not and was assessed by calculating the area under receiver operating characteristic (ROC) curve. A value of 0.5 indicated that the model is equivalent to pure chance and a value of 1 indicates perfect discrimination.

RESULTS

A total of 1064 adult patients underwent cardiac surgery during the study period. The demographic features, baseline characteristics and prevalence of risk factors in our population compared to European population are shown in table 2.

To validate the model on our population; its calibration power and discriminatory power were assessed. Using Hosmer-Lemeshow test,

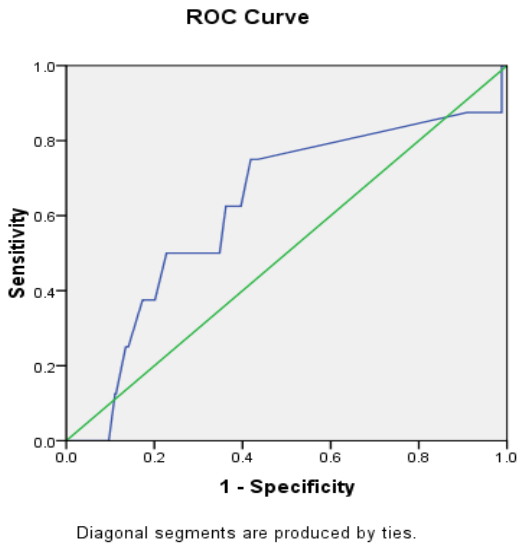

Fig. 1: Area under ROC curve in low risk group (Euroscore 0-2.99).

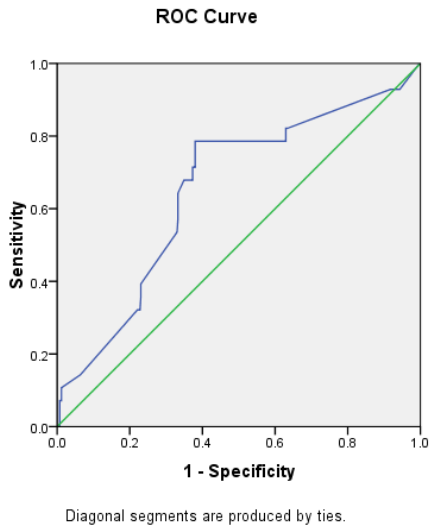

Fig. 2: Area under ROC curve in moderate risk group (Euroscore 3-5.99).

C-statistic of 4.41 with p=0.73 was obtained indicating satisfactory model fit. Area under ROC was calculated to be 0.753, suggesting a good discriminatory power. The observed mortality in low and moderate-risk patients is similar to predicted mortality as is evident from table 3. However, in high-risk patients, the observed mortality was 18.18% as against a predicted mortality of 8.14%. Overall, the total mortality stood at 5.26% against a predicted mortality of 3.5%.

Area under ROC curve was calculated for low, moderate, high and total number of patients respectively as shown in figures 1, 2, 3 and 4 respectively.

Table No. 1: Logistic EuroSCORE calculator

Patient-related factors			Cardiac-related factors		
Age (years)	0	0	Unstable angina	No	0
Gender	Select	0	LV function	Select	0
Chronic pulmonary disease	No	0	Recent MI	No	0
Extracardiac arteriopathy	No	0	Pulmonary hypertension	No	0
Neurological dysfunction	No	0	**Operation-related factors**		
Previous Cardiac Surgery	No	0	Emergency	No	0
Creatinine > 200 µmol/ L	No	0	Other than isolated CABG	No	0
Active endocarditis	No	0	Surgery on thoracic aorta	No	0
Critical preoperative state	No	0	Post infarct septal rupture	No	0
Logistic EuroSCORE	0				
Clear					

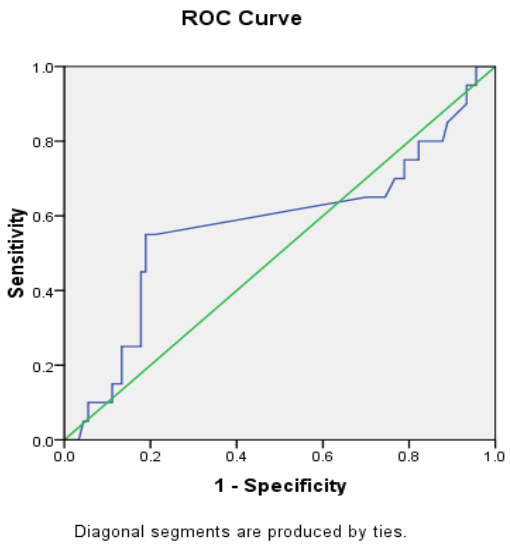

Fig. 3: Area under ROC curve in high risk group (Euroscore >6).

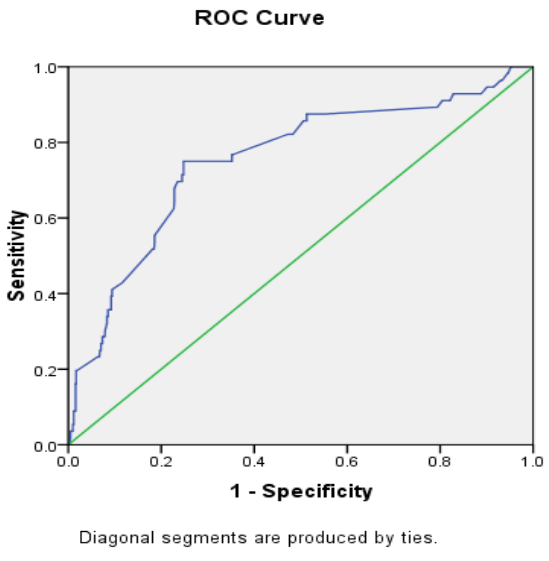

Fig. 4: Area under ROC curve in total number of patients.

Table-2: The demographic features, baseline characteristics and prevalence of risk factors in our population compared to European population.

	European prevalence (%)	Pakistani prevalence (%)
No. Of patients	19 030	1064
Risk factors		
Age	62.5	49.26
Female	27.8	39.86
Chronic pulmonary disease	3.9	2.5
Extra-cardiac arteriopathy	11.3	2.8
Neurological dysfunction disease	1.4	3.2
Previous cardiac surgery	7.3	1.69
Serum creatinine level >200mmol/L	1.8	1.52
Active endocarditis	1.1	0.2
Critical pre-operative state	4.1	3.5
Unstable angina	8.1	6.4
LV dysfunction(LVEF>30)	5.8	4.9
Recent myocardial infarct	9.7	1.7
Pulmonary hypertension	2.0	19.7
Emergency	4.9	4.0
Other than isolated CABG	36.4	34.9
Surgery on thoracic aorta	2.4	Nil
Post-infarct septal rupture	0.2	0.3

Table-3: Comparison of low, moderate and high risk groups.

EUROSCORE	No. of Patients	Observed mortality	Predicted mortality	Area under the curve. (ROC)	95% confidence interval
Low risk(0-2)	505	08 (1.6%)	1.87%	0.622	0.417-0.828
Moderate risk(3-5)	449	28 (6.2%)	4.19%	0.653	0.547-0.759
High risk(>6)	110	20 (18.18%)	8.14%	0.574	0.415-0.733
Total	1064	56 (5.26%)	3.5%	0.753	0.682-0.824

DISCUSSION

Logistic EuroSCORE model is a simple and easily applicable risk assessment tool to predict mortality in cardiac surgical patients. The Pakistani population is different from Western population from which most of the current risk-stratification models including EuroSCORE have been developed. The difference lies in patient demographics (malnourished, small stature), delayed clinical presentation due to socioeconomic, cultural and geographic reasons, inequitable distribution of medical facilities, and a high endemicity of subclinical inflammation, infection and rheumatic heart disease.

The demographic differences are evident in our study wherein the mean age of patients undergoing surgery was 49.26 years as against 62 years in European population[2]. Although the percentage of patients undergoing valvular surgery is almost similar in Pakistani and European population, age-related degenerative valvular heart disease is more common than rheumatic valvular heart disease in Europeans[13]. In Pakistan, rheumatic heart disease is still the leading cause of valvular heart disease[14] and the patients usually present at a young age. Therefore, significant issues in patients with valvular heart disease such as type and number of valves involved (e.g. mitral valve disease, aortic valve disease, double valve disease etc), congestive heart failure, co-morbidities like hepatic or renal dysfunction may have been missed during development of this model. Despite being sicker at a younger age, they are at low risk as per the Euro SCORE model wherein age > 60 years is a risk factor. Since the patients undergoing cardiac surgery are young, they are less likely to have the risk factors mentioned in the EuroSCORE model. This is evident from a decreased prevalence of

risk factors like chronic obstructive pulmonary disease, extracardiac arteriopathy, elevated serum creatinine, critical preoperative state, recent myocardial infarction, and unstable angina in our patients. The prevalence of left ventricular dysfunction as evident by decrease in ejection fraction and neurological dysfunction is similar in the two populations. Pulmonary artery hypertension (PAH), described as systolic pulmonary artery pressures > 60 mm Hg, was observed in 19.7% of our patients as against only 2% of patients in Europe. This again can be attributed to valvular heart disease and usual delayed presentation of patients in Pakistan. PAH alone is a significant cause of mortality in valvular heart disease.

Yap et al. could not validate the model in Australia because of different patient demographics and clinical profile in terms of higher prevalence of risk factors[9]. They reported a significantly low mortality as compared with predicted mortality using EuroSCORE. Of late it has been realized that the additive EuroSCORE model overpredicts mortality in low-risk patients and under predicts mortality in high-risk patients[10,11]. This essentially translates into a scenario where the subsets of patients who are likely to benefit the most from surgery are denied the chance of being operated upon and vice versa. To overcome this problem, a logistic model of EuroSCORE was developed and reported to be superior to additive EuroSCORE for high-risk patients[12]. In our study logistic EuroSCORE almost predicts similar mortality in low and intermediate groups while only in high risk group it under-predicts than actual mortality.

Despite the difference in prevalence of risk factors in population, the predicted mortality and observed mortality were almost similar in patients with low risk (EuroSCORE 0-2) and moderate risk (Euro SCORE 3-5). In patients with high risk (EuroSCORE > 6), the observed mortality was significantly high (15.62%, i.e., 15 out of 96 patients) against a predicted mortality of 7.5%. This is in accordance with previous studies wherein it has been reported that EuroSCORE overpredicts mortality in low- and moderate-risk patients and under- predicts mortality in high-risk patients[10-12]. This discrepancy increases with increasing EuroSCORE and is particularly evident at EuroSCORE > 10, as has been reported by Gobashian et al[15] after a systematic review of international performance of EuroSCORE.

CONCLUSION

The Logistic EuroSCORE created a moderately predictive area under the ROC curve for our patient population. Probability of non-survival by logistic regression model for each EuroSCORE risk group is statistically significantly higher compared to the lower risk group. Predictions available from prognostic scoring systems could be useful in decision making when there is uncertainty in whether to carry out surgery or not. Updating and improvisation of EuroSCORE by incorporation of risk factors, which are more prevalent in Pakistan, may enable it to accurately predict mortality in high-risk patients also.

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