Validation of European Score for Cardiac Operative Risk Evaluation in cardiac surgical patients in Nepal

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Abstract:

Introduction: European System for Cardiac Operative Risk Evaluation (EuroSCORE) is the standard tool for risk stratification of patients undergoing cardiac surgery. Before using this tool in any population, its validation needs to be assessed. This study was carried out to check validation in cardiac surgical patients in Nepalese patients.

Method: This is a prospective observational analytical cohort study in 500 patients undergoing cardiac surgery for coronary artery bypass graft (CABG), valve replacement surgeries (mitral valve, aortic valve or double valve replacements) and valve and aorta replacement surgeries (Bentall procedure).

The data were entered in the Microsoft excel software and were analyzed using Chi Square test from Statistical Package for Social Sciences (SPSS Version - 17) package. Calibration power and discriminative power were calculated.

Result: The model's validation was assessed by its calibration and discriminative power. Calibration power was assessed using Hosmer- Lemeshow test (Chi-square test). It gave P value of 0.14 indicating that the model adequately fits the data and can predict mortality. Discriminative power was assessed by calculating area under the receiver operating characteristic (ROC) curve which was 0.71 indicating satisfactory discriminative power.

In low and moderate risk groups, observed and predicted (additive and logistic) mortality were satisfactory. In high risk group, observed mortality was higher than predicted mortality. Logistic EuroSCORE value was nearer to observed value.

Conclusion: EuroSCORE can be applied in Nepalese cardiac surgical patients in low and moderate risk groups satisfactorily though additive EuroSCORE is better in prediction. In high risk groups, logistic and additive EuroSCORE under predicted outcome than the observed mortality. However logistic EuroSCORE was better in this group of patients. EuroSCORE needs to be refined to apply on high risk Nepalese cardiac surgical patients.

Key Words: Additive, cardiac surgical patients, EuroSCORE, logistic, Nepalese

Introduction

European System for Cardiac Operative Risk Evaluation (EuroSCORE) is the standard tool for risk stratification of patients undergoing cardiac surgery. It was developed after multicenter study in eight European countries involving 128 centers analyzing various risk factors in 19030 patients related with postoperative mortality[1]. The variables of this scoring system are based on three major factors related with patient's factors, cardiac related factors and surgery related factors. EuroSCORE divides patients in low, medium & high risk groups. The calculated scores are 0-2, 3-5 & 6 or more respectively for low, medium and high risk groups. The scores are given according to the presence of the risk factors of the patients. The number is related with the mortality of the patient[1].

Risk stratification helps in optimal utilization of resources in cost effective manner and overall improvement in quality of care of the patients.

EuroSCORE is being used widely in European countries and its relevance has been tested in Spain, North America, Denmark, Australia and also in Asian countries like India, Pakistan, and Japan [2,3,4,5,6,7,8,9]. The relevance and the differences of EuroSCORE have been well documented in their studies.

Both additive and logistic method of EuroSCORE calculation has been analysed and both are found to be valid [10].

This study was carried out to see the relevance of EuroSCORE in Nepalese cardiac surgical patients as they are different than European population with regards to patient demographics, spectrum of cardiac disease and its causes and late presentation due to socio-economic factors. For example rheumatic heart disease is the leading cause for valvular heart disease in our country, whereas valvular heart disease in European countries is due to degenerative process as a result of aging process.

Method

This is a prospective observational analytical cohort study in 500 patients carried out in a tertiary level cardiothoracic teaching hospital, in the patients undergoing cardiac surgery for coronary artery bypass graft (CABG), valve replacement surgeries (mitral valve, aortic valve or double valve replacements) and valve and aorta replacement surgeries (Bentall procedure)from 069/2/11 to 071/9/8. (24/05/2012 to 23/12/2014)

Risk factors mentioned in the EuroSCORE model was reviewed during pre anesthetic check up, history & physical examination, and from the investigations of the patients' medical record file. All the 17 risk factors mentioned in the EuroSCORE were entered in the EuroSCORE calculator, which was calculated by the calculator automatically and was recorded as the additive and logistic EuroSCORE for that patient. The EuroSCORE calculator gives the additive risk score and logistic risk score of the patient. The calculated risk factor represents the mortality risk of that patient for the particular surgery. The patients were categorized as patients with low risk, medium risk and high risk according to calculated EuroSCORE of 0-2, 3-5 and >6 respectively. This risk stratification gives the in-hospital mortality rate of the patient. The patients were followed up in the cardiac intensive care unit, to the ward and upto discharge from the hospital.

Both the additive and logistic variation of the EuroSCORE model was analyzed using the EuroSCORE calculator. Calculated outcomes from both the variants were compared with the observed outcome.

The data were entered in the Microsoft excel software and were analyzed using Chi Square test from Statistical Package for Social Sciences (SPSS Version - 17) package. Calibration power and discriminative power were calculated by using Hosmer-Lemeshow test and by calculation of area under the receiver operating characteristic (ROC) curve respectively.

Result

Total of 500 patients had cardiac surgery among which 276 (55.20%) were male. Data were collected according to EuroSCORE patient variables. Prevalence of various risk factors in Nepalese cardiac patients was compared with European prevalence (Table 1).

Table 1 Prevalence of risk factors according to EuroSCORE

Risk Factors		
Patient factors	**European prevalence in %**	**Nepalese prevalence in %**
No. of patients	19030	500
Mean age in yrs	62.5	45.6
Female	27.8	44.80%
Chronic pulmonary disease	3.9	0.60%
Extracardiac arteriopathy	11.3	1.80%
Neurological dysfunction	1.4	1.40%
Previous cardiac surgery	7.3	3.40%
Serum creatinine >200 µmol/ L	1.8	0.40%
Active endocarditis	1.1	0.40%
Critical preoperative state	4.1	0.80%
Cardiac Factors		
Unstable angina	8.1	1.20%
LV dysfunction moderate or LVEF 30-50%	25.6	19.20%
LV dysfunction poor or LVEF< 30%	5.8	3.60%
Recent myocardial infarct	9.7	6.40%
Pulmonary hypertension	2	8%
Operation Factors		
Emergency	4.9	0.60%
Other than isolated CABG	36.4	65.80%
Surgery on thoracic aorta	2.4	1.60%
Postinfarct septal rupture	0.2	0.00%

The model's validation was assessed by its calibration and discriminative power. Calibration power was assessed using Hosmer- Lemeshow test (Chi-square test). It gave value of p=0.14 with C-static of 6.92 indicating that the model adequately fits the data and can predict mortality. Discriminative power was assessed by calculating area under the receiver operating characteristic (ROC) curve which was 0.71 indicating satisfactory discriminative power. Observed and predicted mortality are shown in Table 2.

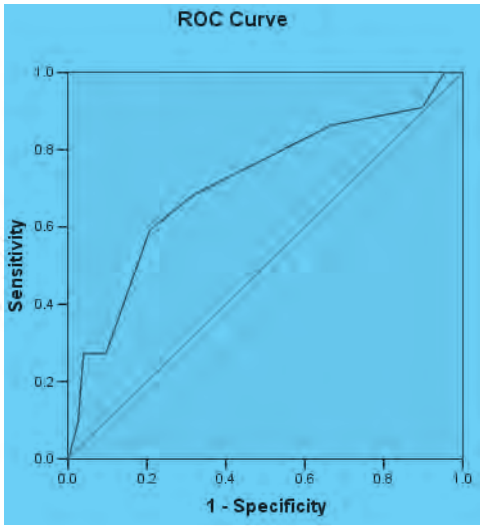

Figure 1 ROC curve for EuroSCORE model

Table 2 Mortality in different risk groups

EuroSCORE	Total cases	Mortality	Observed Mortality %	Predicted mortality	
				Logistic	Additive
	500	22	4.50%	2.82%	3.82%
Low risk (0-2)	162	3	1.85%	1.38%	1.55%
Mod risk (3-5)	286	12	4.12%	2.77%	3.61%
High risk (>5)	52	7	13.46%	8.01%	6.90%

Table 3 Gender wise distribution

Total patients	500	Mortality Observed
Male	276 (55.20%)	10 (3.62%)
Female	224 (44.80%)	12 (5.35%)

Table 4 Types of surgeries

Types of Surgeries	No. of patients (500)	Female (224)	Male (276)	Mortality
Valve	331 (66.2%)	186	150	14
Valve + CABG	4 (0.8%)	2	2	1
CABG	160 (32%)	35	120	5
Bentall procedure	5 (1%)	1	4	2

Table 5 Additive and Logistic EuroSCORE calculator

Patient Factors	Additive EuroSCORE	Logistic EuroSCORE
Age	0	
Sex	1	0.3304052
Chronic pulmonary disease	1	0.4931341
Extracardiac arteriopathy	2	0.6558917
Neurological dysfunction	2	0.841626
Previous cardiac surgery	3	1.002625
Serum creatinine >200 µmol/ L	2	0.6521653
Active endocarditis	3	1.101265
Critical preoperative state	3	0.9058132
Cardiac Factors		
Unstable angina	2	0.5677075
LV dysfunction moderate or LVEF 30-50%	1	0.4191643
Lv dysfunction poor or LVEF<30	3	1.094443
Recent myocardial infarct	2	0.5460218
Pulmonary hypertension	2	0.7676924
Operation Factors		
Emergency	2	0.7127953
Other than isolated CABG	2	0.5420364
Surgery on thoracic aorta	3	1.159787
Postinfarct septal rupture	4	1.462009

Discussion

Risk stratification by scoring system is an efficient way of patient management which allows hospital team to communicate with the patients, compare outcome with different institutions and may be used even for intrahospital comparison at different times and with varied surgical teams [9, 11]. EuroSCORE is one of the most popular and simple scoring system for outcome evaluation of cardiac surgical patients. This scoring system was developed from analysis of large group of patients who had cardiac surgery across Europe and achieved validation in 1999 [1]. As different countries have different demographics and disease patterns than Europe, validation and relevance of this scoring system is studied by many. Studies in Spain, North America and Western Denmark concluded that this scoring system may be used in their patient population [2,3,4]. However in the studies carried out in Australia, India, Pakistan and Japan; EuroSCORE could not predict mortality as was observed and hence concluded that EuroSCORE is not appropriate for the risk analysis. The authors advised that it may need certain changes in variables based on patients' demographics and disease pattern to fit in [5,6,7,8,9]. Study has shown that EuroSCORE is also applicable in thoracic aorta surgeries [9]. In this study, there are 5 patients who had valve and ascending aorta surgery (Bentall procedure). (Table 4)

The Nepali population is different than the European population with regards to patients' demographics, disease pattern and delayed presentation due to ignorance and socio-economic reasons. Mean age was 45.6 yrs in our study (Table 1) whereas in European study it was 62.5 years [1]. Coronary artery diseases and degenerative valvular heart diseases are more common in European population which may be the reason for the greater age of the patients in European study. Comparatively isolated coronary artery diseases are less in this study than European population (34.2% vs 63.6%).

EuroSCORE is developed to predict outcome of cardiac surgery and validation is needed before use in specific subgroups[12].The aim of this study was to validate EuroSCORE model in Nepalese cardiac surgical patients. Calibration power and discrimination power was assessed for the same. Hosmer–Lemeshow test was used to assess calibration power which gave P value of 0.14 showing model adequately fits the data. Discriminative power was assessed by calculating ROC curve which gave area of 0.71 which indicated that the model is able to distinguish between low and high risk groups[12].

In this study, additive and logistic EuroSCORE were compared with the observed mortality. Additive EuroSCORE is simple and predicts mortality better for low risk and medium risk groups, and logistic EuroSCORE is better than additive EuroSCORE for high risk surgical patients[13,6]. In our study also additive EuroSCORE predicted mortality better than logistic EuroSCORE in overall scenario, low risk and high risk groups. Observed mortality was higher in high risk group than prediction by both the system. Yet, logistic EuroSCORE predicted better than additive EuroSCORE in this subset of patients. (Table 2) In some of the other studies also it was found that EuroSCORE underpredicts mortality in high risk groups [6,10,11,14,15]. This difference in high risk group could be due to higher number of female patients, more patients with pulmonary hypertension and large group of patients with rheumatic valvular heart disease (other than isolated CABG)[1] (Table 1).

Rheumatic valvular heart diseases are more common and though patients are young, they present at late stage of disease with related complications like calcified unrepairable valves, congestive heart failure and liver dysfunction, which might have direct effect on outcome of the patients. Those variables are missing from EuroSCORE[1]. Due to average age of presentation, majority of the patients are at lower or moderate risk according to EuroSCORE on the age basis as age > 60 years only is the risk factor, and they do not have other co-morbidities like chronic obstructive airway diseases, extra cardiac arteriopathy and critical preoperative state. Fourth to fifth decade of life is the average age of presentation of rheumatic heart disease patients[16]. So the sicker patients might fall in low or moderate risk groups. Delayed presentation of the patient with rheumatic mitral valvular heart disease may be the cause of increased incidence of pulmonary hypertension in our patient population (8% vs 2%).

Conflict of interest: None declared.

Conclusion

Additive and logistic EuroSCORE can be applied in Nepalese cardiac surgical patients in low and moderate risk groups satisfactorily though additive EuroSCORE is better in prediction. In high risk groups, logistic EuroSCORE was found to be better than the additive EuroSCORE. However it still under predicts outcome than the observed mortality. So EuroSCORE needs to be refined based on risk factors associated with rheumatic heart disease to apply on high risk Nepalese cardiac surgical patients.

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