

## Comparison of EuroSCORE II with EuroSCORE in Cardiac Surgical Patients in a Tertiary Level Teaching Hospital 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. Its relevance has been validated in European, Asian countries and also in Nepal. Its limitations led to development of EuroSCORE II. This study was carried out to compare EuroSCORE II with EuroSCORE in Nepalese cardiac surgical patients.

#### Methods

A retrospective analytical cohort study of 3 years duration in 972 adult cardiac surgeries was conducted. Scores obtained from EuroSCORE (Logistic and Additive) and EuroSCORE II was compared with the observed mortality. Calibration was calculated by Hosmer- Lemeshow (H-L) test (Chi Square test) and discrimination by calculating the area under the curve (AUC) of receiver operating characteristics (ROC) curve.

#### Results

Observed mortality was 4.11%. EuroSCORE additive, logistic and EuroSCORE II predicted mortality were 4.32%, 4.55% and 2.13% respectively. H-L chi square calculation for EuroSCORE additive model could not hold as all observed and expected frequencies match exactly. Hence it can be considered as a good fit. EuroSCORE logistic model (H-L, Chi-square 7.743,  $p < 0.001$ ) and EuroSCORE II (H-L, Chi-square 11.631,  $p = 0.168$ ) also showed good fit i.e. both can predict mortality satisfactorily. AUC of ROC curve of EuroSCORE additive, logistic and EuroSCORE II were 0.632, 0.636 and 0.616 respectively, which showed fair discrimination power.

#### Conclusion

Mortality prediction of adult cardiac surgical patients by EuroSCORE (additive and logistic) and EuroSCORE II was satisfactory.

**Keywords:** Additive, cardiac surgical, EuroSCORE, logistic

## INTRODUCTION

**E**uropean System for Cardiac Operative Risk Evaluation (EuroSCORE) is the standard tool for risk stratification of patients undergoing cardiac surgery. It was developed after multicentric study in eight European countries involving 128 centers analyzing various risk factors in 19030 patients related with postoperative mortality.<sup>1</sup> The variables of this scoring system are based on three major areas, which are patient's factors, cardiac related factors and surgery related factors. EuroSCORE divides patients in low, medium and high risk groups. The calculated scores are 0-2, 3-5 and 6 or more for low, medium and high risk groups respectively. The scores are given according to the presence of the risk factors of the patients which are related to the mortality of the patient. Risk stratification helps in optimal utilization of resources in cost effective manner along with overall improvement in the quality of patient care.

EuroSCORE is being used widely in European and North American countries and its relevance has also been proven in countries like Australia, India and Nepal.<sup>2-6</sup> Additive and logistic method of EuroSCORE calculation has also been found to be valid in several studies.<sup>2-6</sup>

EuroSCORE has also been validated in Nepalese cardiac surgical patients.<sup>6</sup> Validation was necessary as our patient population is different than that of European population with regards to patients' demographics, spectrum of cardiac disease and its causes and delayed 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.<sup>3,6</sup>

EuroSCORE II is updated and found to be accurate in predicting cardiac operative risk in some studies while in others its calibration was found to be poor to predict mortality in cardiac surgical patients.<sup>7-14</sup> EuroSCORE II was updated after multicenter study in 22,381 consecutive patients undergoing major cardiac surgery in 154 hospitals in 43 countries.<sup>7</sup> The need was felt to revise it as it was observed that previous EuroSCORE overestimated the mortality risks and is inadequately calibrated in current cardiac surgical scenario.<sup>15-19</sup>

This study was carried out to compare EuroSCORE II with additive and logistic EuroSCORE in Nepalese cardiac surgical patients. EuroSCORE has been validated but relevance of EuroSCORE II in these patients has not been studied.

## METHODS

This is a retrospective analytical study including 972 adult cardiac surgical patients who

underwent coronary artery bypass graft (CABG), valve replacement or combine surgeries at Manmohan Cardiothoracic Vascular & Transplant Center (MCVTC), Maharajgunj Medical Campus (MMC), Institute of Medicine (IOM), Maharajgunj, Kathmandu, Nepal after approval from the institutional review committee.

EuroSCORE (logistic and additive) were calculated by using EuroSCORE electronic calculator which was compared with the score obtained by EuroSCORE II and both were compared with the observed actual mortality separately. Calibration was calculated by Hosmer-Lemeshow test (Chi Square test) and discrimination was calculated by calculating area under the curve (AUC) of receiver operating characteristics (ROC) curve.

## RESULTS

A total of 972 patients were included in the study out of which isolated CABG cases were 317, valve cases were 631 and combined (CABG+ valve were 24). The mean age in our study was  $46.96 \pm 15.2$  years. Our dataset consisted of 45.47% females. The details of EuroSCORE II predictors are given in Table 1.

The data were also divided according to the predicted risk into low risk, moderate risk and high risk. The risk category wise observed and predicted mortality by EuroSCORE (additive and logistic) and EuroSCORE II is tabulated in Table 2.

EuroSCORE additive model was checked for its goodness of fit, i.e. calibration power, with Hosmer-Lemeshow Chi-Square test. Hosmer-Lemeshow Chi square calculation could not hold as all observed and expected frequencies match exactly, hence it can be considered as a good fit. Additive score shows significant association with mortality ( $p < 0.001$ )(Table 3). As EuroSCORE additive score increased a unit, there was 2.84 times more likelihood for mortality. Observed mortality was 4.11% whereas EuroSCORE additive predicted mortality was 4.32%.

EuroSCORE logistic model was checked for its goodness of fit, i.e. calibration power, with Hosmer-Lemeshow test, Chi-Square of 7.743 with  $p = 0.36$  which shows good fit i.e. it can predict mortality well Table (4b). Observed mortality was 4.11% whereas EuroSCORE logistic predicted mortality was 4.55%. One unit increase in logistic score was associated with 1.21 times more likelihood of mortality ( $p < 0.001$ )(Table 4a).

EuroSCORE II model was checked for its goodness of fit, i.e. calibration power, with Hosmer Lemeshow test, Chi-Square of 11.631 with  $p = 0.17$  which shows good fit i.e. it can also predict mortality in Nepalese cardiac surgical patients who have undergone CABG or valve surgeries (Table 5b). One-unit increase in

Table 1. Details of European System for Cardiac Operative Risk evaluation scoring system variables

Variables	EuroSCORE II	Study EuroSCORE II
Number	22381	972
Age (in years)	64.6±12.5	46.96 ± 15.2
Female	30.8	45.47%
COPD	10.7	0.5%
Extracardiac arteriopathy		2.26%
Neurological dysfunction	3.2	0.6%
Previous cardiac surgery		3.39%
Active endocarditis	2.2	0.1%
Critical preoperative state	4.1	0.4%
Poor mobility		0
IDDM	7.6	5.35%
Unstable angina		0.8%
LV dysfunction moderate or LVEF 30-50%		17.38%
LV dysfunction poor or LVEF<30%		2.57%
Recent myocardial infarct		3.29%
Pulmonary hypertension Mod PASP 31 – 55		4.6% (45)
Pulmonary hypertension Sev PASP > 55		1.44% (14)
Urgent	18.5	0
Emergency	4.3	0.31%
Isolated CABG	46.7 (10448)	31.67 % (308)
Single Non CABG	31.6(3892)	64.19% (624)
2 procedures	22.6(2791)	4.01% (39)
3 procedures	5.6(696)	0.1% (1)
Surgery on thoracic aorta	7.3	1.03%
NYHA I		
NYHA II	32.9%(4060)	72% (703)
NYHA III	9.7%(1194)	26% (252)
NYHA IV	1.3%(163)	2% (17)

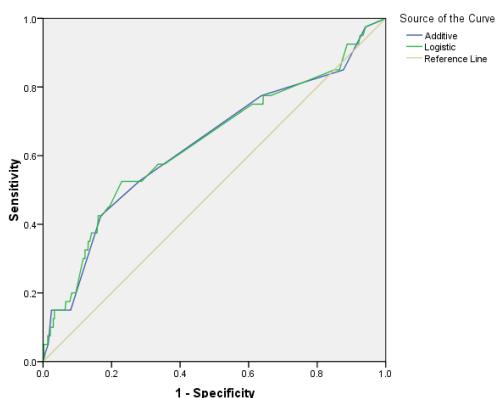


Fig 1. AUC of ROC of EuroSCORE Additive and Logistic model

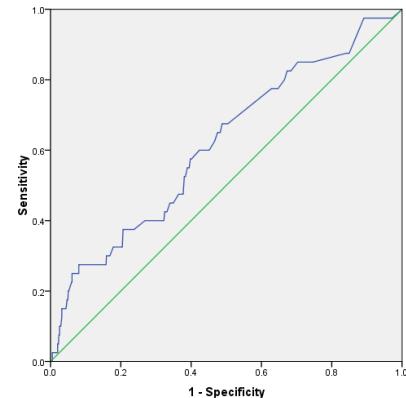


Fig 2. AUC of ROC of EuroSCORE II model

Table 2. Demographic and model wise distribution of mortality prediction

EuroSCORE		Observed Mortality	Mortality by sex		Predicted Mortality (%)		
Risk	Score		Male	Female	Additive	Logistic	Euroscore II (%)
Low	0 – 2	9 (2.6%)	8	1	1.22	1.28	0.97 (0.88 - 1.51)
Moderate	3 – 5	25 (4.6%)	8	17	4.04	3.20	1.51 (0.69 - 3.88)
High	>5	6 (7.4%)	3	3	6.65	9.18	3.92 (2.82-6.19)
Overall		40 (4.11 %)	19 (1.95%)	21 (2.16%)	4.32	4.55	2.13

EuroSCORE II was associated with 1.33 times more likelihood of mortality ( $p=0.008$ )(Table 5a).

AUC of ROC of EuroSCORE additive was 0.632, for EuroSCORE logistic it was 0.636 and for EuroSCORE II it was 0.616 which showed that all the three scoring systems showed fair discrimination (Figure 2 and 3).

## DISCUSSION

EuroSCORE is used widely.<sup>2-6</sup> It was developed after a multicentric study in eight European countries including 128 centers analyzing various risk factors related with postoperative mortality in 19,030 patients.<sup>1</sup> EuroSCORE was being used in clinical practice for many years. EuroSCORE has been validated in Nepalese cardiac surgical patients.<sup>6</sup>

Due to changes in cardiac surgical population, surgical techniques and perioperative care, EuroSCORE estimation of mortality was found to be exaggerated.<sup>8,15-20</sup> Predictive value of EuroSCORE II has been tested in several countries and was found to be better in predicting mortality, while in some centers it was found to be equally predictive as EuroSCORE.<sup>7-11</sup> Predictive value and applicability of EuroSCORE II has not been studied in Nepalese population. So this study was carried out to analyze the predictive value of the EuroSCORE II model in adult cardiac surgical patients undergoing CABG, valve or combined surgeries.

As this study was carried out in tertiary level university hospital, patient population represents the general cardiac surgical population which makes it a homogenous group. Mean age of patient in our study was found to be lower than the EuroSCORE II population which could be due to more number of rheumatic heart disease patients in our population subset coming for valvular surgeries (64.9 % vs. 31.6%). As age was found to be a significant predictor of mortality after 60 years in EuroSCORE II, it may have led to difference in prediction of mortality in the study group of patients.<sup>8</sup>

More female patients were there in our study than EuroSCORE II database (45.47% vs. 30.8%). This could be due to higher prevalence of female patients with rheumatic valvular heart disease being treated for valve surgeries in our part of world. 21 Valve only surgeries was 65 % (n=634) out of which female patients were 57% (n=363).

Chronic lung disease patients in our study were less than EuroSCORE II (0.5% vs. 10.7%) probably due to the presentation of patients at younger age in our group than EuroSCORE II, (mean age in years 46.96 vs. 64.6). More prevalence of smoking in general population in European countries than in Nepal could be other contributing factor.<sup>22</sup>

Emergency cardiac surgeries, thoracic aorta surgeries, critical preoperative state were less in

our patient population in comparison to EuroSCORE II patient population which were 0.31% vs. 4.3%, 7.3% vs. 1.03% and 4.1% vs. 0.4% respectively.

Valve surgeries are higher in our study along with associated risk factors like left atrial appendage (LAA) clot, large left atrium (LAL), LAL reduction plasty may need to be enrolled as risk factors in our subset of population which may increase underestimated risk score by EuroSCORE II in comparison to observed mortality (2.13 % vs 4.11%).<sup>14</sup>

Incidence of Insulin Dependent Diabetes Mellitus (IDDM) is almost similar in EuroSCORE II and our study (7.6% vs. 5.35%). Long duration of uncontrolled IDDM is known to cause diffuse coronary vascular disease<sup>14</sup> which is common in our patient population. However, duration of IDDM is not included as a risk factor.

Alcazar et al. validated EuroSCORE II in 3,798 patients, concluding that EuroSCORE II was a good discriminative method but with poor calibration whereas in this study, calibration was better with both scores and discrimination was fair.<sup>23</sup> In our study mortality of the sample was under predicted by EuroSCORE II as compared to observed mortality (2.13% vs. 4.32%).

Till date, a few studies have shown good calibration and discrimination with EuroSCORE while others have only shown good calibration. On the other hand, some have found EuroSCORE II good discriminated in their patient population which may demand some changes in EuroSCORE II system or development of an all new scoring system as per cardiac disease spectrum in their population. In our population EuroSCORE is better in predicting mortality when compared to EuroSCORE II.

Both EuroSCORE (additive and logistic) and EuroSCORE II models predict mortality satisfactorily in adult cardiac surgical patients, however mortality prediction was more precise by EuroSCORE (additive and logistic) model. Fair discriminative power of both the scores may suggest that they may be less fit for adult cardiac surgical patients undergoing CABG, valve or combined surgeries which may warrant different scoring system or further modification of those scoring systems for more precision.

## CONCLUSION

Hence we can conclude that EuroSCORE (Additive and Logistic) and EuroSCORE II show good calibration but fair discrimination in Nepalese cardiac surgical patients.

## CONFLICT OF INTEREST

None declared.

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