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Prediction of Early and Late mortality outcome in patients undergoing Valvular Heart surgeries using EuroSCORE II

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ABSTRACT

BACKGROUND: The European System for Cardiac Operation Risk Evaluation (EuroSCORE) is one of the possible tools to assess the peri-operative mortality risk in patients undergoing cardiac valvular surgeries. In order to improve the poor calibration and to optimize EuroSCORE usefulness, an updated version of this model named as EuroSCORE II, was better calibrated than the original model in detecting hospital mortality preserving high discrimination.

OBJECTIVES:(1).Preoperative EuroSCORE Calculation in cardiac surgical patients undergoing valvular heart surgeries (2).Analysing one week, one month, 6 months, 1 year, mortality in these patients (3). A Corelation of preoperative risk evaluation by EuroSCORE II with postoperative mortality.

STUDY DESIGN: A prospective observational study.

PARTICIPANTS:A total of 56 patients of any gender, age of more than 18 years, admitted for elective or urgent cardiac valve surgeries over a period of two years were included in the study.

METHODS: Baseline and peri-operative data was collected prospectively which included the variables needed to estimate the operative risk based on EuroSCORE II. The risk score was determined with an online interactive calculator(http://www.euroscore.org/calc.html).Patients were followed prospectively in the post-operative period at one week, one month, at six months and at the end of one year. The primary end point was in hospital mortality and mortality upto one year. Early mortality was taken as mortality at the end of one week and one month and late mortality was taken at the end of six months and one year. During follow up, data was obtained through outpatient clinical review.

RESULTS:

There was no significant difference between expected and observed mortality in accordance to the EuroSCORE II model ($p = 0.076$) suggesting good calibration of the model in this population for early mortality. The area under the receiver operating characteristic (ROC) curve for EuroSCORE II was 0.85 (95% CI 0.712- 0.921) indicating a good discriminatory power for early mortality.The area under the ROC curve of EuroSCORE II for predicting late mortality was 0.493 (95% CI 0.367-0.641) indicating a poor discriminatory power.

CONCLUSIONS:

EuroSCORE II has a good discriminatory power and calibration for prediction of early mortality (in hospital mortality and mortality upto 1 month). The EuroSCORE II estimated risk should not be considered a direct measure of long term mortality as its predictive power(performance) decrease significantly for mortality at a follow up longer than 30 days.

INTRODUCTION

Valvular heart disease (VHD) is one of the most important cardiovascular diseases with its prevalence differing regarding age, gender and different societies[1]. There are various etiologies of VHD including rheumatic, degenerative, traumatic, congenital, and infectious heart diseases. VHD remains common in developing countries, because the increase in prevalence of rheumatic heart diseases[2]. Surgery performs a main role in order to treat the patients with VHDs, which leads to less mortality and better quality-of-life. Heart valve replacement is the second most common type of heart surgery after coronary artery bypass graft surgery[3]. Different postoperative complications are associated with this procedure. In past studies, the rate of mortality following heart valve replacement was reported from 4.3% to 14%[3]. Thus, preoperative risk stratification is critical and assists in decision-making directed towards the patient, taking into account their risk factors, chances of complications and mortality.

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The scores mostly used in the context of valve surgery are : EuroSCORE[4], STS score[5], Ambler score[6], Parsonnet score. The European System for Cardiac Operation Risk Evaluation (EuroSCORE) is one of the possible tools to assess the operative mortality risk[7-9] .The first EuroSCORE, initially based on an additive system derived by a logistic regression model, was developed on data collected in 1995 and reported in 1999 to predict in-hospital or 30-day mortality[7-8]. Recently, in order to improve the poor calibration and to optimize EuroSCORE usefulness, an updated version of this model has been proposed for the assessment of cardiac surgical risk[9]. The new score, named EuroSCORE II, was better calibrated than the original model in detecting hospital mortality preserving high discrimination[9].

MATERIAL AND METHODS

This Prospective, observational study was conducted at Sher-i-Kashmir Institute Of Medical Sciences, Srinagar during 2018-2021.A total of 56 patients were included in our study.Patients with physical status ASA I, II, III and IV of any gender age of more than 18 years, admitted for elective or urgent cardiac valve surgeries were included in the study. Baseline and operative data was collected preoperatively which included the variables needed to estimate the operative risk based on EuroSCORE II. Definitions proposed by EuroSCORE were fully adopted, and the risk score was determined with an online interactive calculator (http://www.euroscore.org/calc.html).Patients were followed prospectively in the post-operative period at one week, one month, at six months and at the end of one year. The primary end point was in hospital mortality and mortality upto one year. Early mortality was taken as mortality at the end of one week and one month and late mortality was taken at the end of six months and one year. During follow up, data was obtained through outpatient clinical review.

STATISTICAL METHOD

The recorded data was compiled and entered in a spreadsheet (Microsoft Excel) and then exported to data editor of SPSS Version 20.0 (SPSS Inc., Chicago, Illinois, USA). Continuous variables were expressed as Mean±SD and categorical variables were summarized as frequencies and percentages. Graphically the data was presented by bar and pie diagrams. ROC analysis was employed to determine the performance of EuroSCORE II for predicting early and late mortality. A P-value of less than 0.05 was considered statistically significant. All P-values were two tailed.

RESULT

Out of the 56 patients included in our study, a total of 9 (16.1%) patients expired, while 47 patients survived.

EARLY MORTALITY The observed early mortality rate was 8.9% .A total of 5 patients expired during the 1st month after surgery. Out of these 5 patients 4 patients expired in the first week after surgery.

Table : Risk category wise observed and predicted mortality by EuroSCORE II

Risk catogary	No. of patients	Observed mortality	Predicted mortality
Very low risk(<1)	13	0	0.68
Low risk(1-2.99)	18	1	1.61
Moderate risk(3-4.99)	12	1	4.55
High risk(>5)	13	3	8.96
Total	56	5	3.73

The observed and predicted mortality (early mortality) was 0% and 0.68 % in the very low risk group, respectively. In the low risk group, observed early mortality was 5.6% whereas predicted early mortality was 1.61%. In the moderate risk group, observed early mortality was 8.3% while the predicted mortality by EUROSCORE II was 4.55%. In high risk group, the observed early mortality was 23.1% whereas the predicted mortality was only 8.96%. Overall, observed early mortality rate was 8.9% in comparison to the predicted mortality rate of 3.73 % by EUROSCORE II.

Table : Calibration and discrimination of EuroSCORE II for early mortality

Statistical measure	value
Hosmer-Leeve Chi-square	14.23
P-value	0.0076
Area under curve	0.835
95% cl	0.712-0.921

The Hosmer-Lemeshow goodness-of-fit test did not show significant difference between expected and observed early mortality in accordance to the EuroSCORE II model (Chi-square = 14.23, p = 0.076) suggesting good

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calibration of the model in this population. The area under the receiver operating characteristic (ROC) curve of EuroSCORE II for predicting early mortality is 0.835 (95% CI 0.712-0.921) indicating a good discriminatory power.

Graph: depicting calibration and discrimination of EuroSCORE II for early mortality

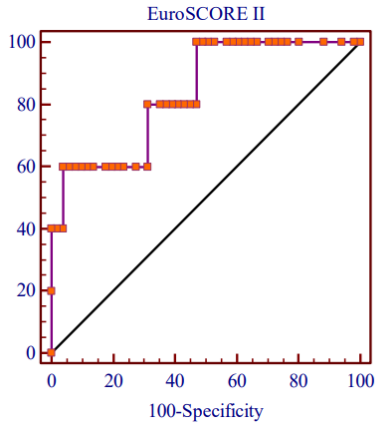
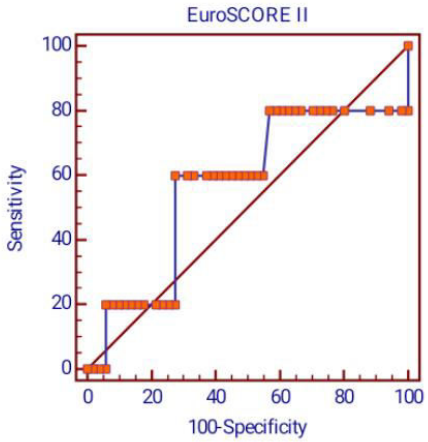


Table : Discrimination of EuroSCORE II For late Mortality

Statistical measure	Value
Area under curve	0.493
95% cl	0.367-0.641

The area under the receiver operating characteristic (ROC) curve of EuroSCORE II for predicting late mortality is 0.493 (95% CI 0.367-0.641) indicating a poor discriminatory power. Therefore the EuroSCORE II cannot be used for predicting late mortality as its performance fades for mortality at follow-up longer than 1 month

Graph : depicting discrimination of EuroSCORE II for late mortalit



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DISCUSSION

Local validation and implementation of updated operative risk scores are necessary to enhance the quality of patient care. Improvement of surgical techniques and perioperative medical attention have significantly reduced cardiac surgery mortality in the past few years, despite older and sicker patients. Most predictive models in cardiac surgery use early mortality as an endpoint and most cardiac surgical registries follow patients only to the point of discharge from the hospital. However, it is well known that 30-day or in-hospital mortality is only one aspect of the periprocedural mortality[21]. Therefore, a sophisticated risk stratification system needs to consider the late outcomes[22] too. EuroSCORE II was published in 2011, as the earlier versions (additive and logistic EuroSCORE) had a tendency to overestimate the mortality[10].The EuroSCORE II had both good discrimination and good calibration for the entire data series and had the best discriminatory power in the subgroup of patients who underwent an isolated, non-CABG procedure (e.g. AVR/TVR/MVR repair). It is understandable that the demographics, patient profile and contemporary surgical techniques and practices are different in the Indian subcontinent as compared to the rest of the world. Thus, the EuroSCORE database population is unlikely to be representative of Indian demographics. Because of similar concerns external validation has been carried out and published from UK[11,14,15], Argentina[16], China[13] ,Greece[17],Netherland [19] Malaysia [20].In India three earlier studies have attempted validation of EuroSCORE II[12,18,23]. These studies were carried out in urban centres and had a predominance of CABG surgery. The present study ,however, more likely is to be representative of the general population as it is carried out in government teaching hospital and our study consists of valvular heart surgeries only. The result of our study showed that EuroSCORE II has a good calibration and discriminatory power for valvular heart surgeries in this population. Age was found to be a significant predictor of mortality from 60 years onwards in the EuroSCORE II analysis[10]. However, the mean age in our dataset was significantly lower(48.6) as compared to EuroSCORE II. Females constituted 53.6% of our sample which is higher than EuroSCORE II database (30.9%), whereas in the study by Borde *et al*[12].(19.89%), Biju Sivam Pillai et al[23](27%), Kar P Geeta et al[18](33.5%) patients were females. In our study patients underwent only valvular heart surgeries. In our study none of the patients had a history of recent myocardial infarction. 36 patients had mild pulmonary hypetension, 19 patients had moderate pulmonary hypertension and only 1 patient had severe pulmonary hypertension and 1 patient had poor mobility. In the Indian subcontinent, the major cause of valvular heart disease is still rheumatic in origin as opposed to the Western population where the degenerative valvular lesions are predominant[2,3].

In our study, 14 patients had diabetes and were on insulin. Insulin dependent diabetes mellitus (DM) has been identified as a risk factor in EuroSCORE II database, but it does not take into account the duration of DM, which can have a significant impact on the nature of disease. The Indian population has a genetic predilection for DM, and early onset of DM is common. In our experience, most patients from lower socioeconomic strata have a long duration of uncontrolled diabetes and often have diffuse disease at the time of admission.

In our study, the observed early mortality and predicted early mortality was 0% and 0.68 % in the very low risk group, respectively. In the low risk group, observed early mortality was 5.6% whereas predicted early mortality was 1.61%. In the moderate risk group, observed early mortality was 8.3% while the predicted mortality by EUROSCORE II was 4.55%. In high risk group, the observed early mortality was 23.1% whereas the predicted mortality was only 8.96%. Overall, observed early mortality rate was 8.9% in comparison to the predicted early mortality rate of 3.73 % by EUROSCORE II. Hence, we found that mortality was well predicted in very low-risk group and low risk-group whereas mortality was under-predicted in moderate and high risk groups using EuroSCORE II. The previous study on Indian population by Borde *et al*. reported a slight under-prediction in low-risk groups and over prediction in moderate and high risk groups. Pillai *et al*. also observed overestimation of mortality using EuroSCORE II. Kar P Geeta et al observed that mortality was well predicted in the very low-risk group, but it was under-predicted in low,moderate and high-risk groups. However, we must emphasize the fact that most patients in the above three studies underwent CABG as well as valvular surgeries whereas,in our study we have taken into account only valvular heart surgeries. We have conducted this study in government hospital which caters to the need of general population and majority of which comes from low socioeconomic strata. These patients are often from lower socioeconomic status, malnourished and poorly preserved, which can lead to higher mortality. This could be the reason for the difference in prediction capability of their study and our study. In a vast country like India, regional differences in patient demographics, dietary habits, age at onset of disease and disease severity are likely to be present. This can significantly affect the outcome. Thus, we strongly feel that there is a need for

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multicentric study including centres from all regions of the country to validate the model. It may also be beneficial to make modification in the EuroSCORE II by incorporating variables that are important in the Indian context.
However in our study observed late mortality is 7.1%(4 out of 56).All the patients died due to non EuroSCORE II factors like one patient died due to intracranial haemorrhage secondary to deranged anticoagulation. Others died due to heart failure because of paravalvular leak, emboloic stroke and respiratory failure due to bilateral pneumonia (LV failure). The evaluation of long-term mortality after cardiac surgery according to preoperative risk profile is a demanding task.The analysis of long-term effects of variables that define EuroSCORE II could represent the first step in defining a new, useful, parallel tool that can provide core information to both clinicians and the patients. Nonetheless, it should be kept in mind that analysis of the relationship between EuroSCORE II factors and long-term survival excludes some important variables—such as deranged anticoagulation, trauma, smoking, infections, previous hospital admissions, immune-rheumatologic disease, and other comorbidities that modify ,above all, long-term mortality[24] that have a great impact on outcomes and that should be integrated in the algorithm.

LIMITATIONS

1. First limitation was small sample size of our study. A large sample of patients and multicentric study including centres from all regions of the country are needed to further validate the model and give better results.
2. Only isolated valvular heart surgeries were taken into consideration .

CONCLUSION

EuroSCORE II has a good discriminatory power and calibration for prediction of early mortality (in hospital mortality and mortality upto 1 month). The EuroSCORE II estimated risk should not be considered a direct measure of long term mortality as its predictive power(performance) decrease significantly for mortality at a follow up longer than 30 days.

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