The Current Status of EuroSCORE II in Predicting Operative Mortality following Cardiac Surgery

In this issue, Guillet *et al*. compared the prediction of postoperative mortality in high-risk cardiac surgery using additive European System for Cardiac Operative Risk (aES), logistic EuroSCORE (lES), and EuroSCORE II (ESII) risk models in their retrospective study.[1] To make analysis feasible, the authors from the index article categorized surgical population into four groups, in a high-risk category – octogenarians, combined valve and coronary artery bypass grafting (CABG), thoracic aortic surgery, and emergency cardiac surgery, and into two groups in a low-risk category – CABG and valve surgery. The authors analyzed the data using commonly approached methods – discrimination (ability to differentiate between low- and high-risk patients) and calibration (ability to accurately predict the operative mortality). The performance of ESII is much better in low-risk groups and marginally better in high-risk groups similar to the observation by Barili *et al*.[2] Overall, ESII underestimates mortality prediction in high-risk cardiac surgery. This commentary describes briefly the current status of ESII compared with other risk models in predicting operative mortality following cardiac surgery.

EuroSCORE has been used worldwide in the clinical practice since its introduction in 1999.[3] The original aES model generally underestimates morality in high-risk and overestimates it in low-risk patients, and also it was designed primarily using data largely from CABG patients.[4] In 2003, lES scoring system was introduced with use of full logistic equation to improve operative mortality prediction.[5] However, the performance of both models declined progressively over a period of time. This could be due to an increase in operating on older individuals (>70 years), presence of more comorbidities than originally included in the risk score, and advances in the practice of cardiac surgery, which leads to the introduction of ESII in 2012. ESII model is based on a large pool of data of more than 22,000 patients from 43 countries and is derived from a more contemporary data set that reflects the current cardiac practice.[6] The number of variables in ESII is much less than Society of Thoracic Surgeons (STS) scoring and also more flexible to use in a wide range of cardiac surgeries.[7]

Since the introduction of ESII, many studies validate ESII with previous EuroSCORE in most cardiac surgeries.[8] Most of the observations are consistent with index article data showing good calibration with acceptable discrimination when compared with aES and lES. With the inclusion of more clinical set data and more relevant parameters such as well-defined definition for renal impairment, ESII is expected to perform well in a wide range of cardiac surgeries; however, it is still not an ideal model. According to Chalmers *et al*., data from a single center with more than 5000 patients showed that ESII is a better model for combined valve and CABG, best for isolated mitral surgery, and it exhibits poor prediction in isolated CABG compared with aES or lES model. Their analysis also raised concerns in application of ESII in isolated aortic valve replacement and aortic surgeries.[9]

In transcatheter aortic valve implantation (TAVI) surgical population, Dimitri *et al*. observed that a cut-off value of ≥ESII 7% for high-risk category was not reached by more than 50% of patients, and moreover ESII showed very poor discrimination like other risk models.[10] Overall, ESII is still a better risk model compared with lES; however, additional parameters need to be included to establish new "TAVI score" for better prediction.[11] Grant *et al*. in their large analysis from a multicenter, United Kingdom database, described both lES and ESII to have poor discrimination and poorer calibration in an emergency cardiac surgery compared with elective surgery. Certain variables such as female gender, active endocarditis, unstable angina, recent myocardial infarction, chronic obstructive pulmonary disease, and pulmonary hypertension were not identified as significant risk factors for any emergency cardiac surgery.[12]

Even though age is considered as one of the predictors for mortality in certain high-risk surgery, all the existing EuroSCORE models did not include aortic calcification and diffuse coronary disease, important in determining mortality especially above 70 years.[13] Also, a higher number of covariates as risk factors in this age group leads to wider confidence interval in predicting mortality. Both models should be used with caution in patients above 70 years. However, Shan *et al*., in their comparative trial from retrospective data, demonstrated that SinoSCORE achieved better predictive efficiency than ESII especially in octogenarians who underwent CABG.[14]

The inability of all ES models to be able to predict operative morality with near 100% accuracy shows the limitations of any modeling process. However, it creates a broader range of opportunities for improvement in risk scoring system. No current risk model is ideal, considering demographic, institutional, and individual variations in practice, which leads to the difference in observed versus expected predicted mortality. We are hoping to improve risk prediction in future models by addressing commonly encountered issues in clinical practice. To conclude, assignment of any surgical or procedural risk strategy for

any single patient is based on multidisciplinary heart team rather than any risk score system.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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Submitted: 19-Feb-2019
Accepted: 05-Mar-2019
Published: 17-Jul-2020

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Access this article online	
Quick Response Code:	Website: www.annals.in
	DOI: 10.4103/aca.ACA_32_19

How to cite this article: Subramani S. The current status of EuroSCORE II in predicting operative mortality following cardiac surgery. Ann Card Anaesth 2020;23:256-7.