The role of surgical procedures on discriminative performance of the updated euroSCORE II

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The euroSCORE II has recently been developed to increase the performance of the older versions that have been demonstrated to be miscalibrated.¹ Although the core of the algorithm is similar, some new pieces have been added, among them a different classification of operations and a novel categorization of number of procedures. Nonetheless, no data are available regarding the potential relationship between euroSCORE II performance and surgical procedures. The purpose of this study was to evaluate the impact of surgical procedures on euroSCORE II calibration by modeling the receiver operating characteristic (ROC) curve with a generalized linear model.

MATERIALS AND METHODS

Data on 13,871 consecutive patients who underwent cardiac surgery in a 6-year period were retrieved from the institutional databases that are prospectively collected within the departments of cardiac surgery of two university hospitals and one regional hospital in Italy. The relevant institutional review boards approved the data set's use for research. The Institutional Ethical Committees approved the study, and the requirement for informed written consent was waived on the condition that subjects' identities remain masked. Data from the three centers were matched and stored in a dedicated data set. The euroSCORE II was tested on the prediction of in-hospital mortality. Discriminative power was assessed with the c-index (area under the ROC curve [AUC]). To analyze the effect of type of surgery on discriminative power, we modeled the ROC curve with a parametric generalized linear model, with a binormal mode.² Two-sided statistics were performed. For all analyses, the R 2.15.1 software was used.³

RESULTS

The mean value of euroSCORE II was 3.0 ± 4.1 , and the observed mortality was 2.5% (335 patients). The mean age of the study group was 67.4 ± 11.7 years, and 31.4% (4359 patients) were female. A majority of the group underwent isolated or associated coronary artery bypass grafting (CABG; 7449 patients, 53.7%).

A preliminary nonparametric analysis of discrimination showed a worse performance of the euroSCORE II in the surgical subgroups not included in the algorithm, such as aortic valve surgery, mitral valve surgery, tricuspid valve surgery (AUC 0.80, 95% confidence interval [CI] 0.77-0.83 vs AUC 0.87, 95% CI 0.83-0.91 for procedures included in the algorithm; [Figure 1](#))

The multivariable direct parametric modeling of ROC curves with generalized linear model methodology demonstrated that surgery of the mitral valve significantly lowers the discriminative performance of the euroSCORE II by affecting both parameters that define the ROC curve (intercept -0.38 ± 0.16 ; 95% CI -0.68 to -0.05 ; slope -0.36 ± 0.10 , 95% CI -0.57 to -0.15 ; [Table 1](#)), leading to a curve that is closer to the diagonal line. The effect of other procedures is not significant, and the performances for these subgroups of patients are comparable to that for patients undergoing CABG.

DISCUSSION

Perioperative outcomes are known to be influenced by several parameters, including the type of surgical

FIGURE 1. Receiver operating characteristic (ROC) curves for the EuroSCORE II in procedures included (CABG, surgery for aortic disease) and not included (such as aortic valve surgery, mitral valve surgery, tricuspid surgery) in the algorithm. The diagonal line represents no discriminatory power (area under the receiver operating characteristic curve of 0.50).

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TABLE 1. Parameters of the receiver operating characteristic curve after generalized linear modeling

Surgical procedure	Value	95% Confidence interval	P value
Intercept	1.22 ± 0.10	1.04–1.45	<.05
Slope	0.91 ± 0.08	0.78–1.1	<.05
Effect of mitral surgery on intercept	−0.38 ± 0.16	−0.68 to −0.06	<.05
Effect of mitral surgery on slope	−0.36 ± 0.10	−0.57 to −0.15	<.05

Receiver operating characteristic curve is defined by 2 parameters, *intercept* and *slope*. The only covariate significantly affecting the receiver operating characteristic curve parameters was mitral valve surgery, which negatively affected discriminative performance.

intervention, and different surgical procedures are therefore expected to exert different effects on the prediction of in-hospital mortality. The Society of Thoracic Surgeons score was developed from data from distinct surgical populations, and the weight of procedures in risk prediction was underscored and included in the model.⁴ In contrast, the recently released euroSCORE II categorizes surgeries in general classes, privileging the role of the number of procedures without differentiating among non-CABG procedures.¹ In this analysis, we have demonstrated that the discriminative performance of euroSCORE II is higher for surgical categories included in the algorithm, such as CABG or surgery for aortic disease, whereas it decreases in other classes. Nonetheless, the only covariate that significantly affects the ROC curve is surgery for mitral disease, which decreases the performance of the score. The discriminative power of euroSCORE II significantly worsens when applied to mitral surgery, although it still remains satisfactory (AUC 0.79, 95% CI 0.74–0.84). Previous validation studies have demonstrated good discrimination in the case of both isolated CABG and aortic valve replacement, although no composite evaluation of all surgical subgroups has been performed.^{5,6}

The identification of independent predictors of discriminatory accuracy should lead to covariate adjustment or to the incorporation of such factors in the score algorithm. Nonetheless, further studies from larger data sets are needed

to focus in addition on the roles of diverse surgical techniques for the same disease, because the classification of surgeries that we tested is generic. The general category “surgery for mitral disease,” and also other surgical categories, includes different treatment options that can have an effect on outcomes.

The more complex categorization introduced in the updated euroSCORE II to update the older versions still seems inadequate. Further testing and refinement of the algorithm should include further surgical categories, and even subcategories.

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Single-lung transplants: The fate of the second donor lung

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Patients listed for lung transplants still suffer from lack of available donor organs. In France between 2004 and 2009, an average of 31 patients yearly died while on the waiting list.¹ Single-lung transplants (SLTs) have the theoretic advantage of increasing access to transplantation by sharing a single donor between 2 recipients who become “twinning.” Twinning SLTs (TSLTs) are feasible even in a single center, without impairment of outcome in the second recipient despite longer ischemia.² The real benefit of TSLT