Letter to the Editor

The logistic EuroSCORE

Dear Sir,

The European System for Cardiac Operative Risk Evaluation (Euro-SCORE) identifies a number of risk factors which help to predict mortality from cardiac surgery.[1] The predicted mortality (in percent) is calculated by adding the weights assigned to each factor. Since its initial publication in 1999, EuroSCORE has been widely used in Europe and elsewhere and has been the subject of several studies. Most of these studies compared the predictive ability of the EuroSCORE to previously described systems[2,3] or to locally derived models.[4] One original work used it as a tool in order to assess the intra-institutional benefit in switching from conventional surgery under cardiopulmonary bypass to the off-pump approach in coronary surgery.[5] In general, EuroSCORE was found to be an easy tool for inter-institutional comparison with good or excellent predictive ability. Nevertheless, many observers noted a trend to an underestimation of the operative risk in very high-risk patients, and it has been suggested that full statistical comparison to other systems might be difficult since comprehensive information on the logistic regression equation of the score was never published.

EuroSCORE was initially designed to be a user-friendly system, in the hope of encouraging as many units as possible to embark on programmes of risk-adjusted quality monitoring. In this setting, although derived from a logistic regression methodology, only the simple additive version of the score was originally published. This score could be easily calculated at the bedside[4,5] and could therefore be

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Table 1 Logistic regression model of EuroSCORE in the 1995 pilot study

Variables	β Coefficient
Age (continuous)	0.0666354
Female	0.3304052
Serum creatinine >200 μmol/l	0.6521653
Extracardiac arteriopathy	0.6558917
Pulmonary disease	0.4931341
Neurological dysfunction	0.841626
Previous cardiac surgery	1.002625
Recent myocardial infarct	0.5460218
LVEF 30–50%	0.4191643
LVEF <30%	1.094443
Systolic pulmonary pressure >60 mmHg	0.7676924
Active endocarditis	1.101265
Unstable angina	0.5677075
Emergency operation	0.7127953
Critical preoperative state	0.9058132
Ventricular septal rupture	1.462009
Other than isolated coronary surgery	0.5420364
Thoracic aortic surgery	1.159787
Constant β_0	−4.789594

LVEF, left ventricular ejection fraction; full definition of these variables are published[1] and can be seen on-line (http://www.euroscore.org).

used widely in Europe even in hospitals with little information technology. Today, European cardiologists and cardiac surgeons are demonstrating a growing interest in quality control and have access to ever better information technology resources. Some may therefore wish to use a more sophisticated risk model than the simple additive Euro-SCORE. For this reason, we seek to make public the full details of the EuroSCORE logistic regression equation (Table 1). Using the same risk factors, the logistic regression version of the score (the 'logistic EuroSCORE') can be calculated. For a given patient, the logistic EuroSCORE which is the predicted mortality according to the logistic regression equation, can be achieved with the following formula:

$$\text{predicted mortality} = \frac{e^{(\beta_0 + \Sigma \beta_i \, X_i)}}{1 + e^{(\beta_0 + \Sigma \beta_i \, X_i)}}$$

where β_0 is the constant of the logistic regression equation (see Table 1) and β_i is the coefficient of the variable X_i in the logistic regression equation provided in Table 1. $X_i=1$ if a categorical risk factor is present and 0 if it is absent. For age, $X_i=1$ if

patient age <60; X_i increases by one point per year thereafter (ie: age 59 or less $X_i=1$; age 60 $X_i=2$; age 61 $X_i=3$ and so on).

Cardiologists and cardiac surgeons will be relieved to note that they do not have to face this complex calculation with every patient; a risk calculator (additive and logistic) can be used or downloaded easily from the EuroSCORE website (http://www.euroscore.org).

The additive EuroSCORE is simple, well validated, user-friendly and works at the bedside without specialised equipment. Because of its additive properties, it will tend to underestimate risk in some very high risk groups. The logistic EuroSCORE is more suitable for individual risk prediction in very high risk patients and will facilitate further sophisticated study into the field of risk. Within Europe and elsewhere in the world there are hospitals with rudimentary, if any, data collection and others, where data are abundant and the study of risk is a specialised area of advanced investigation. It can therefore be argued that there is currently a place for both simple as well as

sophisticated risk tools in this rapidly evolving field.

References

1. Nashef SAM, Roques F, Michel P et al. European system for cardiac operative risk evaluation (EuroSCORE). *Eur J Cardiothorac Surg* 1999;**16**(1):9–13.
2. Geissler HJ, Holzl P, Marohl S et al. Risk stratification in heart surgery: comparison of six score systems. *Eur J Cardiothorac Surg* 2000;**17**(4): 400–6.
3. Kawachi Y, Nakashima A, Toshima Y et al. Risk stratification analysis of operative mortality in heart and thoracic aorta surgery: comparison between Parsonnet and EuroSCORE additive model. *Eur J Cardiothorac Surg* 2001;**20**(5):961–6.
4. Pitkanen O, Niskanen M, Rehnberg S et al. Intra-institutional prediction of outcome after cardiac surgery: comparison between a locally derived model and the EuroSCORE. *Eur J Cardiothorac Surg* 2000;**18**(6):703–10.
5. Sergeant P, de Worm E, Meyns B et al. The challenge of departmental quality control in the reengineering towards off-pump coronary artery bypass grafting. *Eur J Cardiothorac Surg* 2001; **20**(3):538–43.

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