

Performance of EuroSCORE II in Hungary: A Single-centre Validation Study



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Background

The efficacy of the updated cardiac surgical risk stratification system, EuroSCORE II, needs widespread assessment in the cardiac surgical centres where it is intended to be used. The present paper is a single-centre validation study carried out in Hungary.

Methods

An adult cardiac surgical cohort of 2287 patients was investigated. The general levels of performance of the logistic EuroSCORE and that of EuroSCORE II were compared using the Hosmer-Lemeshow test, ROC analysis and calculation of the Brier score. The calibrations were visualised by smoothed curves derived with the help of local polynomial regression. The efficacy of EuroSCORE II was analysed in different operation types and urgency subgroups.

Results

The old EuroSCORE over-estimated the risk (O:E ratio: 0.66, HL test, $p < 0.01$), while EuroSCORE II slightly under-predicted mortality (O:E ratio: 1.19, HL test, $p = 0.0084$). Comparing the ROC AUCs, we did not find a significant difference between the accuracy of the old and new versions of EuroSCORE (0.8017, 95% CI: 0.7596–0.8438 vs. 0.8177 95% CI: 0.7786–0.8569). EuroSCORE II performed well among CABG patients (O:E ratio: 0.75, HL test, $p = 0.5789$) and in those who underwent elective surgery (O:E ratio: 1.1, HL test, $p = 0.1396$), but failed in the emergency (O:E ratio: 1.71, HL test, $p = 0.0055$) and salvage (O:E ratio: 1.36, HL test, $p = 0.0245$) categories.

Conclusions

EuroSCORE II proved to be more suitable for cardiac surgical risk prediction compared with its previous version, but its reliability can be questioned among patients who need emergency and salvage surgery, as well as in the case of combined operations.

Keywords

Risk model • Cardiac surgery • EuroSCORE • Mortality • Risk stratification • Validation

Introduction

The recently published EuroSCORE II [1] refreshed our knowledge of adult cardiac surgical risk and gave us an updated tool for everyday practice. The primary aim of risk

stratification is to provide information about the likely outcome for both the patient and the clinicians. The improvement of cardiac surgical care is also based on continuous quality control, in which the expected and the observed outcomes are compared.

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A valid risk stratification system will be of paramount importance in clinical decision making when choosing between cardiac operations and catheter-based interventions, which are now available offering a palliative, but lower-risk solution for an increasing number of cardiac conditions. To confirm the practical usefulness of the new EuroSCORE several external validation studies are needed in different countries.

Our institution participated in the data collection process for the recalibration of EuroSCORE, but neither its present nor its old version [2] has been validated in Hungary to date. The aim of the present study is to examine the calibration and accuracy of EuroSCORE II on a Hungarian adult cardiac surgical population.

We suspected that the performance of EuroSCORE in Hungary might be different from that of other regions in Europe. There are several reasons behind this assumption: (1) different genetic background of the population, (2) socio-cultural aspects, (3) different economic resources of the health care system. These factors are not or poorly represented in the EuroSCORE II. risk model, because the majority of the patients enrolled into the developmental database came from the Western European region, that basically differs from the Eastern and Middle Europe as well as from Asia and Australia in the above-mentioned aspects.

There are certain published data that indirectly suggest a strong genetic influence behind the risk factors of cardiac disease in the Hungarian population. Farsang et al [3] reported increased incidence of cardio-metabolic syndrome in the Central European population compared with other regions of Europe. Beyond the inherited factors the explanations for the unfavourable risk profile in Central-Europe can be life-style (low level of physical exercise and high amount of saturated fat in the diet).

On the bases of the WHO on-line database (<http://www.who.int/countries/en/>) one can explore the differences among the countries which contributed data to the new EuroSCORE. The expenditure on health per capita is around 50% compared with the Western European countries but the hazardous effect of the more frequent smoking places on health care is disproportionally higher. The probability of dying between the 15th and the 60th years of life is more than the double (208/1000) for males in Hungary compared with the Western European data (United Kingdom: 91/1000; Austria: 94/1000; Germany: 96/1000; France: 113/1000). These indices in other Central European countries are the following: the Czech Republic: 132/1000; Slovakia: 170/1000; Poland: 191/1000; Romania: 209/1000; the Ukraine: 310/1000. For comparison the same ratio is 80/1000 in Australia.

The present publication aims at exploring the performance of EuroSCORE II independently of these three non-specified determinants.

In addition to describing EuroSCORE II's general performance, we also aimed to explore its efficacy in the different cardiac surgical groups, as well as in the urgency categories.

Patients and Methods

The recruitment of the validation cohort started on 1st November 2010 and ended on 31st January 2013 in a single cardiac surgical centre, shortly after the data collection for EuroSCORE II ended. All the patients who underwent major cardiac surgical procedures (CABG, AVR, MVR, mitral valve repair, ascending aorta replacement or repair, atrial septal defect closure, atrial myxoma excision, or a combination of these) were enrolled and followed up to the 30th postoperative day. The same risk predictors were collected as had been provided for the developmental EuroSCORE II database, but none of the patients was included in both datasets. All the patients enrolled into this validation study signed an informed consent form in which they agreed with the use of the data collected for their disease, their treatment and outcomes for scientific and publication purposes. The study was approved by the local ethical committee. The only outcome parameter was in hospital mortality within this period.

For the calculation of the logistic EuroSCORE and the EuroSCORE II p-values, the online tools were used that can be found on the website: www.euroscore.org.

The distribution of the calculated risks was depicted on a Logistic EuroSCORE-EuroSCORE II-scatter plot with different symbols for the survivors and non-survivors.

The basic overall performance parameter was the observed to expected mortality ratio (O:E ratio). The practical meaning of the individual logistic EuroSCORE and EuroSCORE II p-value is the probability of death within 30 days following the operation. The expected mortality was calculated by averaging out these probabilities [4].

Calibrations of the scores were evaluated using the Hosmer-Lemeshow test. The expected mortalities in the deciles of the predicted risk were calculated on the basis of both models, similar to above, by averaging the individual p-values and comparing them with the observed mortality in each decile. The difference between the observed and the expected mortality was considered to be statistically significant if the HL-test result was <0.05 [4]. In order to demonstrate the goodness-of-fit visually, calibration curves were created by using a smoothing method. These curves are the results of a local polynomial regression where Epanechnikov kernel function was used with a bandwidth of 0.05 [5].

The accuracy or discriminative power of the risk stratification models were analysed by using the receiver operation characteristics (ROC) method. The area under the ROC curves and their 95% confidence intervals were calculated and compared [4].

As another general measure of accuracy the Brier score of each individual outcome prediction was calculated according to the following formulas:

Brier score (BS) = $(p-1)^2$ if the patient died and $(p-0)^2$ if the patient survived, where p is the probability of mortality within 30 days following the surgery, predicted by either the logistic EuroSCORE or EuroSCORE II [4]. The reported BS values are the means of these individual Brier scores. If we know the outcome, the Brier score is zero when the prediction is perfect

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