EuroSCORE predicts postoperative mortality, certain morbidities, and recovery time.

Hitoshi Hirose  
*Division of Cardiothoracic Surgery, Department of Surgery, Thomas Jefferson University; Juntendo University Hospital*

Hirotaka Inaba  
*Juntendo University Hospital*

Chiaki Noguchi  
*Department of Surgery, Tokyo University; Medical Association Towa-kai*

Keiichi Tambara  
*Juntendo University Hospital*

Taira Yamamoto  
*Juntendo University Hospital*

Follow this and additional works at: [https://jdc.jefferson.edu/surgeryfp](https://jdc.jefferson.edu/surgeryfp)

**Recommended Citation**  
Hirose, Hitoshi; Inaba, Hirotaka; Noguchi, Chiaki; Tambara, Keiichi; Yamamoto, Taira; Yamasaki, Motoshige; Kikuchi, Keita; and Amano, Atsushi, "EuroSCORE predicts postoperative mortality, certain morbidities, and recovery time." (2009). *Department of Surgery Faculty Papers*. Paper 55.  
[https://jdc.jefferson.edu/surgeryfp/55](https://jdc.jefferson.edu/surgeryfp/55)

---

This Article is brought to you for free and open access by the Jefferson Digital Commons. The Jefferson Digital Commons is a service of Thomas Jefferson University's Center for Teaching and Learning (CTL). The Commons is a showcase for Jefferson books and journals, peer-reviewed scholarly publications, unique historical collections from the University archives, and teaching tools. The Jefferson Digital Commons allows researchers and interested readers anywhere in the world to learn about and keep up to date with Jefferson scholarship. This article has been accepted for inclusion in Department of Surgery Faculty Papers by an authorized administrator of the Jefferson Digital Commons. For more information, please contact: JeffersonDigitalCommons@jefferson.edu.
Authors
Hitoshi Hirose, Hirotaka Inaba, Chiaki Noguchi, Keiichi Tambara, Taira Yamamoto, Motoshide Yamasaki, Keita Kikuchi, and Atsushi Amano

This article is available at Jefferson Digital Commons: https://jdc.jefferson.edu/surgeryfp/55
EuroSCORE predicts postoperative mortality, certain morbidities, and recovery time
Hitoshi Hirose, Hirotaka Inaba, Chiaki Noguchi, Keiichi Tambara, Taira Yamamoto, Motoshige Yamasaki, Keita Kikuchi and Atsushi Amano
*Interact CardioVasc Thorac Surg* 2009;9:613-617; originally published online Jul 13, 2009;
DOI: 10.1510/icvts.2009.210526

The online version of this article, along with updated information and services, is located on the World Wide Web at:
http://icvts.ctsnetjournals.org/cgi/content/full/9/4/613
Institutional report - Cardiac general

EuroSCORE predicts postoperative mortality, certain morbidities, and recovery time

Hitoshi Hirose*1,4, Hirotaka Inaba*, Chiaki Noguchi*2, Keiichi Tambara*, Taira Yamamoto*, Motohide Yamasaki*, Keita Kikuchi*, Atsushi Amano*

*Department of Cardiovascular Surgery, Juntendo University Hospital, 2-1-1 Hongou, Bunko-ku, Tokyo 113-8421, Japan
1 present address: Division of Cardiothoracic Surgery, Department of Surgery, Thomas Jefferson University, 1025 Walnut Street Room 605, Philadelphia, PA 19107, USA. Tel.: +1-215-955-6925; fax: +1-215-925-8386.
2 present address: Medical Association Towa-kai, 2-407-2 Shinozaki-machi, Edogawa-ku, Tokyo, 133-0061, Japan.
* Corresponding author.
E-mail address: genex@nifty.com (H. Hirose).

© 2009 Published by European Association for Cardio-Thoracic Surgery. All rights reserved.

Keywords: EuroSCORE; Complication; Coronary artery disease

1. Introduction

EuroSCORE (European System for Cardiac Operative Risk Evaluation) is a risk calculation system for predicting postoperative mortality of patients undergoing cardiac surgery. EuroSCORE was developed in the late 1990s in Europe [1], and was quickly accepted in the US [2], Japan [3], and other countries [4]. The mortality rate of coronary artery bypass grafting (CABG) (n = 1552) performed between 1991 and 2006 at our hospital group were placed into a systematic database. Patients were stratified using additive EuroSCORE. Incidence of postoperative mortality, morbidity (bleeding, heart failure, mediastinitis, pneumonia, myocardial infarction, renal failure, and stroke), and recovery time (intubation time, ICU stay, and postoperative length of stay) was assessed in each EuroSCORE group. EuroSCORE was well correlated with mortality, total incidence of major complications, heart failure, renal failure, stroke, pneumonia and mediastinitis, and three parameters of recovery time. Postoperative myocardial infarction and incidence of bleeding were not correlated with EuroSCORE. EuroSCORE can predict not only mortality but also postoperative complications and recovery time.

© 2009 Published by European Association for Cardio-Thoracic Surgery. All rights reserved.

Keywords: EuroSCORE; Complication; Coronary artery disease

2. Methods

Consecutive cases of isolated on-pump CABG performed between 1991 and 2006 at our hospital group (n = 1552) were placed into the systematic database, which was approved for research by the internal review board. Patient demographics were presented as mean ± S.D. or percentage as appropriate.

Additive EuroSCORE was calculated for each patient based on original EuroSCORE criteria [2]. Zero score was given for factors not used for isolated CABG, such as active endocarditis, other than isolated CABG, surgery on the thoracic aorta, or postinfarct septal rupture. The score for pulmo-

Table 1

<table>
<thead>
<tr>
<th>Patient factors</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years ± S.D.)</td>
<td>63.3 ± 9.3</td>
<td>21.9</td>
</tr>
<tr>
<td>Female sex</td>
<td>340</td>
<td>21.9</td>
</tr>
<tr>
<td>Chronic pulmonary disease</td>
<td>62</td>
<td>4.0</td>
</tr>
<tr>
<td>Extracardiac arteriopathy</td>
<td>108</td>
<td>7.0</td>
</tr>
<tr>
<td>Neurological dysfunction</td>
<td>153</td>
<td>9.9</td>
</tr>
<tr>
<td>Previous cardiac surgery</td>
<td>50</td>
<td>3.2</td>
</tr>
<tr>
<td>Serum creatinine 200 μmol/l</td>
<td>61</td>
<td>3.9</td>
</tr>
<tr>
<td>Critical preoperative state</td>
<td>16</td>
<td>1.0</td>
</tr>
<tr>
<td>Cardiac factors</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unstable angina</td>
<td>224</td>
<td>14.4</td>
</tr>
<tr>
<td>LV dysfunction (EF 30–50%)</td>
<td>297</td>
<td>19.1</td>
</tr>
<tr>
<td>LV dysfunction (EF &lt; 30)</td>
<td>38</td>
<td>2.4</td>
</tr>
<tr>
<td>Recent myocardial infarction</td>
<td>65</td>
<td>4.2</td>
</tr>
<tr>
<td>Surgical factors</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emergent surgery</td>
<td>110</td>
<td>7.1</td>
</tr>
<tr>
<td>EuroSCORE</td>
<td>2.9 ± 2.2</td>
<td>41.4</td>
</tr>
<tr>
<td>Other factors</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diabetes</td>
<td>642</td>
<td>41.4</td>
</tr>
<tr>
<td>Distal anastomosis</td>
<td>3.3 ± 1.2</td>
<td>41.4</td>
</tr>
</tbody>
</table>

© 2009 Published by European Association for Cardio-Thoracic Surgery
nary hypertension was not incorporated into this study due to a lack of data on preoperative pulmonary artery pressure. EuroSCORE above 10 was found in a relatively small number of patients (30 patients) and the EuroSCORE range spread widely between 10 and 17; thus these patients were excluded from the analyses (however, it was marked as a reference point). All off-pump procedures (n = 1395) were excluded from this study to avoid selection biases for off-pump CABG.

Postoperative mortality, morbidity (bleeding requiring reoperation, postoperative heart failure requiring inotropic support for more than five days, mediastinitis with deep sternal infection, pneumonia, postoperative new Q-wave myocardial infarction, renal failure newly required temporally or permanent dialysis, and postoperative stroke confirmed by CT-scan) and postoperative recovery time (intubation time, ICU stay, and postoperative length of stay) were analyzed in each EuroSCORE group (0–9). In addition to those cited above, major complications included, critical arrhythmia (ventricular fibrillation, recurrent ventricular tachycardia, bradycardia requiring a permanent pacemaker), pulmonary emboli, respiratory failure requiring prolonged ventilator support for more than five days, reintubation or tracheostomy, sepsis, and acute graft occlusion.

The adequacy of the correlation between the EuroSCORE and outcomes was assessed by the correlation coefficient (r). Correlations were considered adequate if r value was above 0.60 and P-value was < 0.05. Then, the receiver operating characteristics (ROC) curve was constructed and the area under the curve was calculated. Area under the ROC curve was used as an index indicating the appropriateness of the model in which EuroSCORE could predict a postoperative complication. The model was considered excellent if the area under ROC curve was > 0.80, very good if > 0.75 and good if > 0.70. All statistical analyses were performed using JMP software (SAS institute, Cary, NC, USA).

3. Results

Baseline demographics of the study patients are shown in Table 1. EuroSCORE of the study group was 2.9 ± 2.2. Postoperative outcomes and EuroSCORE are shown in Table

Table 3

<table>
<thead>
<tr>
<th>Complication</th>
<th>r</th>
<th>P-value</th>
<th>ROC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Death</td>
<td>0.672</td>
<td>0.0333</td>
<td>0.890</td>
</tr>
<tr>
<td>Major complications</td>
<td>0.928</td>
<td>0.0001</td>
<td>0.705</td>
</tr>
<tr>
<td>Congestive heart failure</td>
<td>0.870</td>
<td>0.0011</td>
<td>0.856</td>
</tr>
<tr>
<td>Renal failure</td>
<td>0.866</td>
<td>0.0012</td>
<td>0.873</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>0.845</td>
<td>0.0021</td>
<td>0.813</td>
</tr>
<tr>
<td>Stroke</td>
<td>0.874</td>
<td>0.0010</td>
<td>0.771</td>
</tr>
<tr>
<td>Mediastinitis</td>
<td>0.641</td>
<td>0.0460</td>
<td>0.760</td>
</tr>
<tr>
<td>Bleeding</td>
<td>0.526</td>
<td>0.1185</td>
<td></td>
</tr>
<tr>
<td>Perioperative myocardial infarction</td>
<td>0.033</td>
<td>0.9269</td>
<td></td>
</tr>
<tr>
<td>Intubation time</td>
<td>0.847</td>
<td>0.0020</td>
<td></td>
</tr>
<tr>
<td>ICU stay</td>
<td>0.837</td>
<td>0.0025</td>
<td></td>
</tr>
<tr>
<td>Postop stay</td>
<td>0.937</td>
<td>0.0001</td>
<td></td>
</tr>
</tbody>
</table>
2. Results of correlation and ROC analyses are shown in Table 3. The incidence of postoperative mortality (Fig. 1a), major complications (Fig. 1b), heart failure (Fig. 1c), renal failure (Fig. 2a), postoperative pneumonia (Fig. 2b), stroke (Fig. 2c), and mediastinitis (Fig. 2d) were positively correlated with EuroSCORE. Intubation time (Fig. 3a), ICU stay (Fig. 3b), and postoperative length of stay (Fig. 3c) were also positively correlated with EuroSCORE. Postoperative bleeding or myocardial infarction was not correlated with EuroSCORE.

4. Comments

Additive EuroSCORE was chosen for our analysis because of the simplicity of calculation. Logistic EuroSCORE could more precisely estimate the postoperative mortality rate after cardiac surgery than the additive EuroSCORE [8, 9]; however, the calculation of logistic EuroSCORE is far more complex than additive EuroSCORE, and requires computer
Fig. 3. (a) Intubation time and EuroSCORE were well correlated ($y = e^{0.22x - 4.47}$). (b) ICU stay and EuroSCORE were well correlated ($y = e^{0.11x - 0.73}$). (c) Postoperative length of hospital stay and EuroSCORE were well correlated ($y = e^{0.08x + 2.59}$).

As expected, mortality rate and EuroSCORE were highly correlated with each other compared to other postoperative complications and EuroSCORE according to ROC analyses, since EuroSCORE was designed for the estimation of postoperative mortality. Complications other than bleeding or perioperative myocardial infarction were positively correlated to EuroSCORE. According to ROC analyses, prediction of postoperative complications was excellent for death, heart failure, renal failure, and pneumonia, very good for stroke and mediastinitis, and good for overall major complications.

We used exponential transformation ($y = e^{ax + b}$) of the estimation-curve to show better correlation between EuroSCORE and each complication. Each complication acted in a similar manner along with EuroSCORE, such that the complication rate remained relatively low between EuroSCORE 0 and 5; then it acutely increased after EuroSCORE 6 or above. To show this behavior, an exponential curve ($y = e^{ax + b}$) was more suitable than a straight line ($y = ax + b$). Previously, Sergeant found that EuroSCORE overestimated the risk from 0 to 8, was appropriate from 9 to 11, then underestimated the risk at 12 or higher [11], which reflect our observation that each complication and EuroSCORE had an exponential relation, although our study was limited to EuroSCOREs between 0 and 10. Furthermore, EuroSCORE 6 has often been used as a cut-off to identify high-risk patients [9, 12, 13].

Perioperative myocardial infarction and bleeding were independently observed from EuroSCORE. A reason some postoperative complications not related to EuroSCORE could be because these occurrences were more likely related to technical issue or factors not picked up by EuroSCORE. For example, technical problems such as anastomosis of small target vessel that may be related to diabetes, or an intraoperative event such as the use of intraaortic balloon pump in patients who were unable to be weaned from cardiopulmonary bypass are not counted in EuroSCORE. Preoperative use of antiplatelet agents, which may be related to postoperative bleeding [14], is not incorporated in EuroSCORE either.

Postoperative intubation time, ICU stay and postoperative hospital stay were positively related to EuroSCORE. These parameter may be simply related to the fact of the higher complication rate in the high-risk group. EuroSCORE will identify the high-risk patient easily. To avoid postoperative complication and prolonged stay, the surgical strategy and care for these high-risk patients should be individually tailored.

There are several limitations in this study. First, this is a retrospective, non-randomized, observational study, although the data were entered in a prospective manner. Second, this study was performed at a single institution. Our institution did not have a back-up rehabilitation facility, which may have promoted prolonged hospital stay. Third, patients with high EuroSCORE above 10 comprised a relatively small percentage of our study population, although the majority of patients undergoing isolated CABG was included in this study.

In conclusion, EuroSCORE well predicts not only mortality, but also certain postoperative complications and recovery time. EuroSCORE can be a useful tool to predict prognosis after isolated CABG.

References


deComment: Does EuroSCORE predict postoperative complications?

Authors: Leo A. Bockeria, Bakoulev Scientific Center for Cardiovascular Surgery, Roublevskoye Sh. 135, 121552 Moscow, Russia; Ivan I. Skopin, Yuliya S. Dmitrieva

doi: 10.1510/icvts.2009.210526A

We would like to comment the author’s article with our experience. When we started the investigation, the 1000 consecutive cases of adult open heart valve surgery took place over a three-year period. Logistic EuroSCORE was applied to predict operative mortality. Postoperative mortality, morbidity and postoperative length of stay were analyzed. EuroSCORE had an area under the receiver operating characteristic curve (ROC) of 0.639 for prediction of hospital death, the correlation coefficient (r) was 0.177 and P<0.05. Moreover, EuroSCORE was correlated with postoperative complications: the area under the ROC was 0.668, the correlation coefficient was 0.224. Our finding revealed that EuroSCORE could predict not only mortality but also potential complications after open heart valve surgery. It was noteworthy, that the length of stay did not correlate with EuroSCORE (r=0.08). So, our results also suggested that EuroSCORE was a good predictor for postoperative complications [1, 2].

References


EuroSCORE predicts postoperative mortality, certain morbidities, and recovery time
Hitoshi Hirose, Hirotaka Inaba, Chiaki Noguchi, Keiichi Tambara, Taira Yamamoto, Motoshige Yamasaki, Keita Kikuchi and Atsushi Amano
Interact CardioVasc Thorac Surg 2009;9:613-617; originally published online Jul 13, 2009;
DOI: 10.1510/icvts.2009.210526

This information is current as of October 10, 2009

Updated Information
including high-resolution figures, can be found at:
http://icvts.ctsnetjournals.org/cgi/content/full/9/4/613

References
This article cites 14 articles, 13 of which you can access for free at:
http://icvts.ctsnetjournals.org/cgi/content/full/9/4/613#BIBL

Citations
This article has been cited by 1 HighWire-hosted articles:
http://icvts.ctsnetjournals.org/cgi/content/full/9/4/613#otherarticles

Permissions & Licensing
Requests to reproducing this article in parts (figures, tables) or in its entirety should be submitted to: icvts@ejcts.ch

Reprints
For information about ordering reprints, please email: icvts@ejcts.ch