AusSCORE II in predicting 30-day mortality after isolated coronary artery bypass grafting in Australia and New Zealand

Baki Billah, PhD,[a] Molla M. Huq, MSc,[a] Julian A. Smith, MBBS,[b,c] Fahim Sufi, PhD,[d] Lavinia Tran, PhD,[a] Gilbert C. Shardey, MBBS,[e] and Christopher M. Reid, PhD[a]

Objectives: To update the Australian System for Cardiac Operative Risk Evaluation (AusSCORE) model for operative estimation of 30-day mortality risk after isolated coronary artery bypass grafting in the Australian population.

Methods: Data were collected by the Australian and New Zealand Society of Cardiac and Thoracic Surgeons registry from 2001 to 2011 in 25 hospitals. A total of 31,250 patients underwent isolated coronary artery bypass grafting and the outcome was 30-day mortality. A total of 2154 (6.9%) patients had 1 or multiple missing values. Missing values were estimated assuming missing completely at random and logistic regression with a generalized estimating equation was used to address within-hospital variance. Bootstrapping methods were used to construct and validate the updated model (AusSCORE II). Also the model was validated on an out-of-creation sample of 4700 patients who underwent bypass surgery in 2012.

Results: The average age of the patients was 65.6 ± 12.9 years and 78.6% were male. Thirteen variables were selected in the updated model. The bootstrap discrimination and calibration of the AusSCORE II was very good (receiver operating characteristics [ROC], 82.0%; slope calibration, 0.987). The overall observed/AusSCORE II predicted mortality was 1.63% compared with the original AusSCORE predicted mortality of 1.01%. The validation of the AusSCORE II on the out-of-sample data also showed a high performance of the model (ROC, 84.5%; Hosmer-Lemoshow *P* value, .7654).

Conclusions: The AusSCORE II model provides improved prediction of 30-day mortality and successfully stratifies patient risk. The model will be useful to improve the preoperative consultation regarding risk stratification in terms of 30-day mortality. (J Thorac Cardiovasc Surg 2014;148:1850-5)

Supplemental material is available online.

The Australian System for Cardiac Operative Risk Evaluation (AusSCORE) is a 30-day mortality risk prediction model, which was developed for predicting 30-day mortality after isolated coronary artery bypass grafting (CABG) in the Australian population.[1] The AusSCORE model was published in 2009 and was developed based on 7709 patients who underwent isolated CABG from 2001 to 2007 in 6 public hospitals in the state of Victoria, Australia. However, since 2007 more hospitals across Australia now contribute to the Australian and New Zealand Society of Cardiac and Thoracic Surgeons (ANZSCTS) registry and between 2001 and 2011 the database accumulated 53,681 cardiac surgery patients. Of these, 31,250 underwent isolated CABG. For the data from 2001 to 2011, the original AusSCORE model maintained a moderate discrimination power under the area of the receiver operating characteristics (ROC) curve but its calibration was dropped. Thus, the model failed to maintain and optimize its usefulness in contemporary cardiac surgical practice, especially in Australia and New Zealand.

In addition to reduced calibration performance of the original AusSCORE, risk model development techniques have evolved over the past few years resulting in better methods for risk prediction. Model validation improvements include bootstrapping methods that give bias-corrected accuracy indexes of the model and evaluate model specification.[2] The original AusSCORE model was developed only for complete cases and the model did not address within-hospital variation.

Thus, the objectives of this study were to (1) update the original AusSCORE with a larger dataset, (2) estimate missing values, (3) address the within-hospital variation, (4) develop and validate the model using bootstrap methods

From the Departments of Epidemiology and Preventive Medicine,[a] and Surgery,[b] Monash University, Melbourne, Victoria; Department of Cardiothoracic Surgery,[c] Monash Medical Centre, Clayton, Victoria; Department of Defense Canberra, ACT, Australia[d]; and Cabrini Medical Centre,[e] Malvern, Victoria, Australia.

Disclosures: Authors have nothing to disclose with regard to commercial support.

Received for publication July 23, 2013; revisions received Jan 29, 2014; accepted for publication Feb 3, 2014; available ahead of print March 18, 2014.

Address for reprints: Baki Billah, PhD, Department of Epidemiology and Preventive Medicine, Monash University, Melbourne, Victoria 3004, Australia (E-mail: baki.billah@monash.edu).

0022-5223/$36.00

Copyright © 2014 by The American Association for Thoracic Surgery

http://dx.doi.org/10.1016/j.jtcvs.2014.02.027

Abbreviations and Acronyms

AIC	= Akaike Information Criteria
ANZSCTS	= Australian and New Zealand Society of Cardiac and Thoracic Surgeons
AusSCORE	= Australian System for Cardiac Operative Risk Evaluation
CABG	= coronary artery bypass grafting
eGFR	= glomerular filtration rate
EuroSCORE	= European System for Cardiac Operative Risk Evaluation
H-L	= Hosmer-Lemoshow
IV	= intravenous
MI	= myocardial infarction
NYHA	= New York Heart Association
RAMR	= risk adjusted mortality ratio
ROC	= receiver operating characteristics
STS	= Society of Thoracic Surgeons

rather than split-sample methods,[2] (5) evaluate model specification, and (6) develop an online calculator for 30-day mortality risk prediction.

METHODS

ANZSCTS Database

The ANZSCTS prospectively collects information on adult patients undergoing cardiac surgery in Australia. Currently, 25 hospitals across Australia and New Zealand are contributing data to the registry. Participation in the data registry is voluntary in terms of hospitals but if a hospital participates, the surgeons' participation is compulsory. The database prospectively collects 287 preoperative, intraoperative, and postoperative variables. The ANZSCTS data were collected using internationally standardized data definitions.[1,3] The data collection and its audit methods have been discussed previously.[1,4] The variable glomerular filtration rate had maximum missing values (2.58%) followed by ejection fraction estimate (2.52%), urgency of procedures (1.11%), and 30-day mortality (1.01%). The remaining variables had less than 0.12% missing observations. The missing observations were estimated using multiple imputation assuming they were missing completely at random,[12] The primary outcome variable for this study was 30-day mortality. The 30-day mortality status was collected by the hospital data managers by contacting patients, family members, or medical practitioners by follow-up visits or via telephone as part of clinical care.

Statistical Analysis

Stata version 11 (Stata Corporation, College Station, Tex) and R version 2.13.1 (The R Foundation for Statistical Computing) were used for data analysis. Clinical assessment along with the χ^2 test and simple logistic regression were used to identify potential preoperative risk factors for 30-day mortality. Statistically, a variable with *P* value of .25 or less was considered to be a potential risk factor. A bootstrap sample of size n was drawn from the original sample of the same size. The potential risk factors were entered into the multiple logistic regression model and were applied to the bootstrap samples to test the significance of the variables. A variable with a *P* value of less than or equal to .05 was considered significant. The process was repeated 1000 times and the percentage of times that each variable appeared as significant in 1000 bootstraps was recorded. Depending on the percentage of times the potential variables appeared as significant, 4 plausible models were developed. The final model was selected using Akaike Information Criteria (AIC),[5] ROC, and Hosmer-Lemoshow (H-L) *P* value of goodness of fit test. The first-order interaction effect and multicollinearity between clinically relevant risk factors were investigated. A generalized estimating equation was used to account for potential within-hospital variation.[13] The model was validated using bootstrap methods, which provide unbiased estimates of the model's future performance (index-corrected ROC, calibration slope, and graph).[2] The model was also validated for a validation sample. An online risk calculator was developed to predict a patient's preoperative risk of 30-day mortality.

RESULTS

Patient Characteristics

Between 2001 and 2011, the ANZSCTS database accumulated 53,681 patients who underwent cardiac surgery and, of those, 57.6% (n = 31,250) were isolated CABG procedures. From the list of 37 main preoperative variables, the 21 variables that were selected as potential risk factors for 30-day mortality are shown in Table 1. The patient demographics and odds ratio for these variables along with the *P* value and 95% confidence interval are also presented in Table 1.

Compared with the data from which the original AusSCORE was derived (in brackets) patients were similar in age (65.6 ± 12.9 years [65.7 ± 10.1 years]), 78.6% were male (76.8%), and overall 30-day mortality was 1.63% (1.74%). More patients were octogenarians (7.3% [5.3%]), on dialysis (1.6% [1.3%]), and had hypercholesterolemia (81.0% [17.9%]). The definition of hypercholesterolemia has changed for the current data to include anyone being treated for hypercholesterolemia; most cardiac patients are on statins, whether or not they are actually hyperlipidemic. However, fewer patients had a severely impaired ejection fraction estimate (4.3% [5.2%]), New York Heart Association (NYHA) class III or IV (20% [26.3%]), and were classified clinically as emergency or salvage (4.3% [4.6%]).

Risk Model

One thousand bootstrap samples each of the size of the original sample were drawn from the original data. The 21 variables that were selected as potential predictors were entered into a multiple logistic regression model and was run on each of the bootstrap samples. The percentage of times each variable was selected as significant (*P* value ≤.05) was recorded. The following 4 potential models were developed: model 1, variables selected in at least 90% of bootstrap samples (age, ejection fraction estimate, previous cardiac surgery, urgency of procedures, estimated glomerular filtration rate [eGFR], NYHA class, inotrope administration, and myocardial infarction [MI]); model 2, variables selected in at least in 80% of bootstrap samples (all variables in model 1 and 3 additional variables

Download English Version:

https://daneshyari.com/en/article/5989454

Download Persian Version:

https://daneshyari.com/article/5989454

Daneshyari.com