Eur J Vasc Endovasc Surg (2015) 49, 10—16

Editor's Choice - External Validation of Models Predicting Survival After Ruptured Abdominal Aortic Aneurysm Repair CME

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WHAT THIS PAPER ADDS

In patients with a ruptured abdominal aortic aneurysm (RAAA), prediction models could support the decision to select surgical or conservative treatment. In the present study the prediction model "updated GAS" most accurately predicted death, and accuracy was further improved after recalibration. In future clinical practice, the predictions can be used for case mix comparison between hospitals and tailoring the prognosis for patients and relatives. However, the updated GAS was insufficiently accurate to identify patients who would die despite intervention. Therefore, future studies should aim to improve the identification of these high risk patients to support the decision to withhold intervention.

Objective: Prediction of survival after intervention for ruptured abdominal aortic aneurysms (RAAA) may support case mix comparison and tailor the prognosis for patients and relatives. The objective of this study was to assess the performance of four prediction models: the updated Glasgow Aneurysm Score (GAS), the Vancouver scoring system, the Edinburgh Ruptured Aneurysm Score (ERAS), and the Hardman index.

Design, materials, and methods: This was a retrospective cohort study in 449 patients in ten hospitals with a RAAA (intervention between 2004 and 2011). The primary endpoint was combined 30 day or in hospital death. The accuracy of the prediction models was assessed for discrimination (area under the curve [AUC]). An AUC >0.70 was considered sufficiently accurate. In studies with sufficiently accurate discrimination, correspondence between the predicted and observed outcomes (i.e. calibration) was recalculated.

Results: The AUC of the updated GAS was 0.71 (95% confidence interval [CI] 0.66—0.76), of the Vancouver score was 0.72 (95% CI 0.67—0.77), and of the ERAS was 0.58 (95% CI 0.52—0.65). After recalibration, predictions by the updated GAS slightly overestimated the death rate, with a predicted death rate 60% versus observed death rate 54% (95% CI 44—64%). After recalibration, predictions by the Vancouver score considerably overestimated the death rate, with a predicted death rate 82% versus observed death rate 62% (95% CI 52—71%). Performance of the Hardman index could not be assessed on discrimination and calibration, because in 57% of patients electrocardiograms were missing.

Conclusions: Concerning discrimination and calibration, the updated GAS most accurately predicted death after intervention for a RAAA. However, the updated GAS did not identify patients with a ≥95% predicted death rate, and therefore cannot reliably support the decision to withhold intervention.

Article history: Received 5 March 2014, Accepted 11 October 2014, Available online 3 December 2014

Keywords: Aortic aneurysm, Abdominal, Aortic rupture, Decision support techniques, Prediction model, Ruptured abdominal aortic aneurysm

INTRODUCTION

The overall death rate in patients with a ruptured aneurysm of the abdominal aorta (RAAA) is approximately 74% (95% confidence interval [CI] 72—77%).[1] In patients reaching the hospital and undergoing intervention, the death rate ranges between 24% and 49%.[2—4] Surgeons have proposed distinguishing between those who would potentially benefit from surgery, and those in whom it might be better to withhold intervention, for example after cardiopulmonary resuscitation.[5—9] In current clinical practice, the decision to

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DOI of original article: http://dx.doi.org/10.1016/j.ejvs.2014.10.019

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http://dx.doi.org/10.1016/j.ejvs.2014.10.012

start surgical or conservative treatment is based on a fast evaluation of the patients' clinical condition, the surgeon's experience, and the wishes of the patient. It is a subjective interpretation of a harsh reality by the doctor, the patient, and the relatives. A prediction model is a more standardized and objective way to evaluate the chances of successful intervention and might be helpful at these moments of vital choices. Further benefits of prediction models lie in case mix comparison between hospitals and a tailored prognosis for patients and relatives.

Several models have been developed to predict death after intervention in patients with a RAAA: the Glasgow Aneurysm Score (GAS),[10] the Vancouver scoring system,[11] the Edinburgh Ruptured Aneurysm Score (ERAS),[12] and the Hardman index.[6] These scoring systems were initially designed before the introduction of endovascular aneurysm repair (EVAR). Nowadays, EVAR is being carried out increasingly.[2] Only the GAS has been updated to the era of EVAR by the addition of a variable for type of intervention.[13]

The primary objective of the present study was to assess the accuracy of the updated GAS (the model including differentiation between EVAR and OR), the Vancouver score, the ERAS, and the Hardman index in predicting death. Only extremely reliable models, those predicting death accurately in more than 95% of cases, may be useful in clinical decision making. A secondary objective was the assessment of accuracy in patients with a predicted death rate of ≥95% in whom withholding intervention might be considered.

MATERIALS AND METHODS

A retrospective study was conducted in all consecutive surgically treated patients with a RAAA in the Amsterdam ambulance region between May 2004 and February 2011. The present study was carried out as a sequel to the previously published Amsterdam Acute Aneurysm Trial.[14] Other details and analyses of this cohort have been published previously.[14,15] None of these previous studies aimed to validate prediction models for patients with a RAAA. The Amsterdam ambulance region covers an area of 1025 km^2 with 1.38 million inhabitants.[16] During the inclusion period, care for patients with a RAAA was centralized in two university hospitals and one teaching hospital in cooperation with seven regional hospitals. All patients with a RAAA in all ten hospitals of the region were registered prospectively by the vascular surgeons, and included in the present study. Patients with a previous aortic reconstruction, a RAAA with associated trauma or aortoenteric fistula, were excluded. The primary endpoint was the combined 30 day or in hospital death rate. Compared with some previous validation studies of the prediction models, in hospital death was added to the definition; from a patients' perspective the ultimate goal is survival and being discharged. Approval from a medical ethics committee was not needed because of the observational design. This study adhered to the STrengthening the Reporting of Observational studies in Epidemiology (STROBE) guidelines.[17]

Updated GAS

The updated GAS score was calculated with the formula: age (years) + 7 for cardiac comorbidity (defined as previous history of myocardial infarction, cardiac surgery, angina pectoris or arrhythmia) + 10 for cerebrovascular comorbidity (defined as previous history of stroke or transient ischemic attack) + 17 for shock (defined as an in hospital systolic blood pressure <80 mmHg) + 14 for renal insufficiency (defined as a pre-operative serum creatinine >160 μmol/L) + 7 for OR (Fig. S1, online supplement).

Vancouver score

The Vancouver score was calculated with the formula: age (years)*0.062 + loss of consciousness (yes = 1/no = −1) *1.14 + cardiac arrest (yes = 1/no = −1)*0.6 (Fig. S2, online supplement).

ERAS

The ERAS score was calculated with the formula: +1 for best recorded in hospital Glasgow coma scale (GCS) <15, +1 for in hospital systolic blood pressure <90 mmHg, +1 for pre-operative hemoglobin level <5.6 mmol/L. A score of 0 or 1 corresponded with a predicted death rate of 30%, a score of 2 with a predicted death rate of 50%, and a score of 3 with a predicted death rate of 80%.

Hardman index

The Hardman index was calculated with the formula: +1 for age >76 years, +1 for in hospital loss of consciousness, +1 for a pre-operative serum creatinine >190 μmol/L, +1 for pre-operative serum hemoglobin level <5.6 mmol/L, +1 for electrocardiographic (ECG) ischemia (defined as ST segment depression greater than 1 millimeter or an associated T wave change determined by a senior cardiologist [RJGP]). A score of 3 or more corresponded with a predicted death rate of 100%.

Data collection and statistical analysis

Data were collected from the medical records by the first and second authors. Data entry was done using Microsoft Access 2003 (Microsoft Corporation, Redmond, WA, USA) using field limits, univariate and multivariate checks. A valid way of coping with missing values is by imputation.[18] Missing data were imputed for the variables blood pressure, hemoglobin, creatinine, cardiac comorbidity, cerebrovascular comorbidity, resuscitation, loss of consciousness, and GCS. Multiple imputation was done creating ten datasets. Age, sex, renal and pulmonary comorbidity, death, and the above mentioned imputed variables were used as predictors in the imputation model. Baseline characteristics and prediction model scores are reported in both the original dataset and in the imputed datasets (Tables 1 and 2).

The statistical analysis and the imputation procedure were done using IBM SPSS Statistics 19.0 (SPSS Inc.,