Manual for Risk Prediction in Vascular Surgery

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Chapter 1

About

This book is intended as an explanatory text to support the risk tool available at www.vascalc.org.

1.1 Usage

Each chapter here reflects a page of the risk tool that should outline a certain clinical scenario that requires a decision to be made. Each chapter will be broken down into sections that will outline the decision making and available evidence used to provide each presented risk prediction. This risk calculator is developed for the sole purpose of decision support and results should not superscede clinician and patient preference.

1.2 Methods

The multivariable prognostic prediction models included in this project were found through a literature search of available medical databases, bibliography reviews and referrals from content experts. Published algorithms were reviewed and included if they met the following inclusion criteria.

1. Input variables available and commonly collected in the pre-operative setting.
2. Outcome variable relevant to clinician and patient for decision making.
3. Full regression model with beta coefficients and intercept publicly available in publication or through contact with publication authors.

Available risk models were then reviewed and included based on their quality. Quality of risk model was determined according to published TRIPOD guidelines,[Collins et al., 2015, Moons et al., 2015] prioritizing the following values:

1. Clearly described homogeneous patient population that aligns with the clinical question.
2. Model performance assessments, such as AUC, sensitivity or specificity determined through internal and external validation.
3. Parsimonious input variable selection and clear description of variable definitions and manipulations.
4. Transparent stakeholder engagement and algorithm development.

1.3 Feedback

For suggestions, comments or questions please submit an issue on our github page or send us an email.

Chapter 2

Abdominal Aortic Aneurysms (AAA)

The aim of this risk calculator is to assist in the management of patients with asymptomatic infrarenal or juxtarenal aortic aneurysms found incidentally or through screening.

2.1 Input variables

2.1.1 Age

This describes the expected age of the patient at the time of the procedure. This is likely the same age as the patient at the time of the evaluation.

2.1.2 Sex

This describes the documented sex or gender of the patient as recorded in the medical chart.

2.1.3 Maximal Aortic Diameter

This is the maximal aortic diameter in the AP direction reported in mm.

2.1.4 Renal Clamp

This describes whether the surgeon expects to need a clamp above both renals in order to safely complete an open aortic aneurysm repair. Eslami et al includes whether a suprarenal clamp was used in their model for in hospital mortality.@eslami2015 There may be some differences in expected or actual utilization of a suprarenal clamp.

2.1.5 Pior Aortic Surgery

This includes previous endovascular or open aortic surgery. Eslami et al do not described explicitly what is included in this variable, but is it utilized as an exclusion criteria in their model and so we capture it here to ensure their model is not utilized inappropriately for these patients.@eslami2015

2.1.6 History of Coronary Artery Disease

This describes whether the patient has a documented history of coronary artery disease. This is further subdivided into asymptomatic heart disease or unstable/symptomatic heart disease within the past 6 months. Not all models include this subdivision and so asymptomatic and symptomatic disease are often combined when included in models that treat CAD as a binary variable.

2.1.7 Congestive Heart Failure

This describes whether a patient has documented congestive heart failure in their medical record.

2.1.8 Stress Test

This describes whether a patient has undergone a preoperative stress test and the result of this test. If a patient has not undergone a stress test, then the user should select "Not Performed." The model should then be updated once the result of this test is known. Seeing how the result of this test changes the predictions related to post-operative myocardial infarction may help to determine whether this test is warrented in this specific patient.

2.1.9 Cerebrovascular Disease

This describes whether a patient has had a previous cebrovascular event, such as a TIA or stroke.

2.1.10 Chronic Obstructive Pulmonary Disease (COPD)

This describes whether a patient has a documented history of COPD. This is further subdivided into whether the patient is on medications or whether they require home oxygen therapy.

2.1.11 Diabetese

This describes whether a patient has documented diabetes. This is further subdivided into whether their diabetes is controlled with diet, non-insulin medications or requires insulin. This variable does not distinguish Type 1 from Type 2 diabetes, however patients with Type 1 diabetes will likley fall into the category of diabetese requiring insulin therapy.

2.1.12 ESRD

This describes patients with end stage renal disease (ESRD) requiring dialysis, whether peritoneal or hemodialysis. Patients with ESRD on HD are included in the highest Cr or lowest eGFR category for those models that use these variables alone without explicitly stating whether a patient is on dialysis.

2.1.13 Creatinine (mg/dL)

This describes the most recently collected creatinine level. This is not used for predictions in patients with end stage renal disease on dialysis. Cr, age, gender and race are utilized to calculate eGFR for those models that utilize this instead of creatinine alone.

2.2 In-hospital Postprocedural Mortality

The model used for this risk prediction comes from the Vascular Study Group of New England (VSGNE) published in 2015. Eslami et al. [2015]

The patient cohort includes 4,431 patients who underwent elective AAA repair at institutions in Northeastern states on the United States of America (USA) captured in the prospectively collected VSGNE database between 2003 and 2013. This data was collected and maintained by trained nurse and clinical abstractors. The study excluded patients admitted for non-elective AAA repair, who had prior aortic surgery, or those who required a supraceliac clamp so prediction scores are not available for these patients. The outcome of interest was in-hospital postprocedural mortality.

The Model was developed using multivariable logistic regression with backward elimination, setting the alpha=0.2. The sum of the beta estimates was as follows:

Sum of - estimates= {-6.76+ 1.08 (IR AAA) +1.905 (SR AAA)+ 0.78 (Age 75) +0.69 (Female)+0.56 (MCD)+0.71(CVD)+ 0.95(COPD) 0.89 (1.5 Cr<2)+1.31(Cr 2)+0.91(AAA>6.5 cm)}

The authors reported good discrimination of their score with an AUC 0.822. The authors found their score to have better discrimination, when compared to previously publishe models: GAS (AUC 0.685), Medicare (AUC 0.769) and VGNW (AUC 0.767) models. Three additional previously published models were not compared as they included variables not collected by the VSGNE database. The improved discrimination and rigorous data collection in a vascular surgery specific patient population is why we have included this model in our risk score instead of these previously developed models.

We have used this model to provide three prediction values in order to assist with decision making around what procedure to offer a patient presenting for evaluation. The first describes the mortality prediction, assuming that the patient underwent endovascular repair. The second describes the mortality prediction,

assuming the patient underwent an open repair with an infrerenal repair. This open prediction is substituted for a third prediction, if the user signifies that they expect to need a suprarenal clamp for the repair. We have also considered patients who have ESRD on dialysis to be included in the group with Cr > 2, although this is variable assignment is not explicitly stated by the authors. We have color coded the prediction to align with the authors' identified clinical cut points at <1% for low risk (green), 1-8% for moderate risk (yellow), 8-30% for high risk (orange), and >30% for prohibitive risk.

The authors and we have identified a number of limitations. The outcome of interest is in-hospital mortality, which means that this only applies to the index hospitalization. Also, as of now this model has not been externally validated on data collected outside the development registry. Additional variables that may include model discrimination include patient functional status, aortic anatomic characteristics, and center or surgeon volume.

2.3 Post Operative Myocardial Infarcation

Chapter 3

CLTI

The aim of this risk calculator is to assist in the management of patients with asymptomatic infrarenal aortica aneurysms found through screening or incidentally.

3.1 Input variables

3.2 Post-procedural mortality

3.3 Post operative myocardial infarction

Chapter 4

Carotid

The aim of this risk calculator is to assist in the management of patients presenting with carotid artery stenosis and determining the best management strategy.

4.1 Input Variables

4.2 5 year stroke risk

4.3 Post operative Myocardial Infarction

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