VALVULAR HEART DISEASE AND RISK SCORE SYSTEMS IN CLINICAL PRACTICE

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ABSTRACT

Heart valve disease is a very common medical condition; the most frequent aetiology is degenerative valve disease, mainly represented by calcific aortic stenosis in the elderly. In developing countries, valvular heart disease triggered by rheumatic fever is the most important aetiology and can lead to a heterogeneous heart valve disease, mainly represented by mitral stenosis in young female patients. The need for heart valve surgery is common in this context and preoperative risk stratification is essential in making surgical decisions. To evaluate the preoperative risk of these valve heart disease patients, risk scores have been created to assess the surgical morbidity and mortality.

In this article, we aim to discuss the current risk score systems, and the applicability and effectiveness of these systems in specific populations of heart valve disease taking into account the epidemiological characteristics of the studied populations.

Keywords: EuroSCORE (ES), valvular surgery, valvular heart disease.

INTRODUCTION

Valvular heart disease is a worldwide health problem with approximately 275,000 surgeries every year and a mortality rate between 1% and 15%.[1] The main aetiology in the USA and most developed nations is degenerative valve disease, represented by calcific aortic stenosis. Degenerative disease is increasing as a result of population ageing and is the third most common cardiovascular disease after hypertension and coronary artery disease in industrialised countries.[2] In Brazil, and most likely in many other countries in which valvular heart disease is widely prevalent, the major aetiology is rheumatic fever. Rheumatic heart disease (RHD) is by far the most important form of acquired heart disease in children and young adults living in developing countries.[3,4] Despite the fact that it is a preventable illness, approximately 19 million people are affected by it.[5,6] RHD accounts for about 15% of all patients with heart failure in endemic countries[3,4] and 30% of all cardiac surgeries.[3] In RHD, the mitral valve is involved in nearly all cases and the aortic valve is involved in about 30%. The tricuspid valve is commonly affected but is frequently subclinical and associated with mitral valve disease.[3,4]

Rheumatic aetiology presented epidemiological and comorbidity differences when compared with the worldwide population of valvular heart disease. The main differences are represented by a younger age, mostly female, high prevalence of pulmonary hypertension, and atrial fibrillation.[3] Treatment options include medication, percutaneous balloon valvuloplasty, transcatheter replacement, and valve surgery (repair or replacement).[2]

Preoperative risk stratification is essential in making sound surgical decisions. Risk scoring systems have been developed to predict mortality after cardiac surgery in adults. It is worth noticing that scores were developed in the USA and Europe, countries with lower prevalence of RHD and different patient profiles. The main risk factors related to surgical outcomes are: older age, female sex, reduced ventricular ejection fraction, New York Heart Association (NYHA) classification, pulmonary arterial hypertension, reoperation, renal disease, obstructive pulmonary disease, urgent/emergency surgery, infectious endocarditis, and concomitant coronary artery disease.[1,2,7]

With the development of transcatheter aortic heart valve replacement in recent years, indications of valve replacement should be based heavily on the valvular heart team[7] and risk scores. The importance of score validation consequently increases, especially for finding patients with higher risk. Risk scores also support the comparison of outcomes between institutions and surgeons, and make the clinical research communication simple. Therefore, the objective of this article is to review risk stratification in valvular surgery, its limitation in clinical practice, and debate its use in as specific a population as the rheumatic patients.

REVIEWING THE RISK SCORES

Estimating cardiac surgery risk can be challenging, so several scores were created and modified throughout previous decades to help clinicians and surgeons accomplish this task. The scores, mostly used in the context of valve surgery, are: EuroSCORE (ES) II,[8] Society of Thoracic Surgeons (STS) score,[9] and Ambler score.[1] Each score has its own specifications. The ES emerged from the European database with approximately 19,000 patients. Of these, 29% underwent valve surgery. This model has been replaced by the 2011 ES II model which was based upon data from 22,381 patients in 43 countries who were operated on between May and July 2010.[8] Of these, 46% underwent valve surgery. Overall mortality was 3.9% which is lower than would have been predicted by old risk models (ES additive predicted 5.8% and ES logistic predicted 7.6%). The STS score was generated from the USA database which was separated into three large cohorts with >100,000 patients in each. In Groups 2 and 3, only valve surgeries (aortic valve replacement, mitral valve replacement, and mitral valve repair), and combined valve surgery and coronary artery bypass grafting (CABG) were respectively included. The Ambler score, based on 32,839 patients in Great Britain and Ireland, was specifically designed for heart valvular surgery (aortic and mitral) with or without CABG, bringing to discussion the differences among diseases and risks in various procedures.

Two Brazilian models were also proposed for the specific setting of valvular heart disease: the Guaragna score from 2010[10] and the VMCP (heart Valve lesion, Myocardial function, Coronary artery disease, Pulmonary artery pressure).[11] The Guaragna score analysed data from 768 patients, identifying nine predictors of mortality: age >60 years, ejection fraction <45%, female sex, pulmonary hypertension, NYHA III/IV, renal insufficiency, emergency surgery, and concomitant CABG. The score had good validation (area under curve receiver operating characteristic [AUC ROC]: 0.83, 95% confidence interval: 0.78–0.86). VMPC could not predict mortality on the statistical analyses, but a VMPC score >8 was associated with a more advanced illness and increased need for care after procedure. The authors supposed that this lack of prediction in death was due to the small number of patients; both scores were developed with single institution data. Such risk scoring systems are more applicable when the preoperative patient characteristics and treatment profiles are comparable with those from which the system was developed.

Table 1: Score systems and their relevance for valvular heart disease patients.

Score system	Strength of recommendation
EuroSCORE II*	++
STS	++
Ambler	+

*Most studied score system in Brazilian heart valve patients.
STS: Society of Thoracic Surgeons; VHD: valvular heart disease patients.
++strongly recommend; +weakly recommend.

To implement those models, statistical analyses are necessary. The performance is evaluated by the AUC ROC. The STS,[9] Ambler,[1] and ES[8] AUC were 0.80, 0.77, and 0.72, respectively. Usually produced by the Hosmer–Lemeshow test, these scores demonstrated good calibration, on which the mortalities predicted and observed were then compared.

LIMITATION OF THE RISK SCORES IN CARDIAC SURGERY AND ITS APPLICATION IN RHEUMATIC VALVULAR DISEASE

Although risk scores were well validated in many countries[12,13] with significant sample size, they can be inaccurate when evaluating application and individual care in different populations. The choice and total amount of a given risk factor composing a risk model depends on clinical intention,[14] and other factors that could change results are not included in many models such as nutritional status, intra-operatory complications, and frailty. Socioeconomic status, ethnicity, cardiac team experience, healthcare, and living standards, especially in developing countries with high prevalence of rheumatic disease due to the particular differences in this disease population, may also influence surgical results.[13] Local validation should always be conducted and a number of publications have advocated the strategy of local risk score development using particular institution databases.[14-16] An example of inaccuracy can be seen in the comparison of a patient aged 60 years with severe left ventricular dysfunction and an additive ES of 4, and a female 73-year-old patient with no comorbidities who also had an additive ES of 4. These patients definitely do not have the same operative risk, yet they have the same ES risk.[17]

A meta-analysis from Parolari et al.[18] including 26,621 patients showed low discriminatory power of the ES in valvular surgery, as it overestimated mortality rate. An earlier discussion by Ranucci et al.[19] stated that a simpler score with a limited number of risk factors (age, serum creatinine, and ejection fraction) could predict mortality with a good accuracy, although this study was limited to elective cardiac surgery.

ES II is based on recent data and has corrected some variables that could cause loss of discriminatory capacity, and studies are showing better performance. Recently, Billah et al.[15] compared ES and ES II in the estimation of 30-day mortality in valvular surgery, with calibration being markedly improved with ES II. A Pakistani validation study[20] compared ES II with ES and STS in patients undergoing valvular surgery with and without CABG, with better results among ES II.

An important question is the applicability of the scores for all aetiologies in valvular heart disease due to variation of population characteristics and pathophysiology. Few studies have evaluated the risk and validated scores in a population composed only of rheumatic valvular patients. An Australian review from 2014[21] and a Brazilian study[17] found that these patients were younger, needed more frequent reoperation, often had multi-valve repair, and had less need for CABG than other aetiologies. Both studies showed a higher rate of female patients, data of relevance due to the need to manage anticoagulation demands during pregnancy. Despite this consideration, a study published recently showed good application of ES and ES II in a population with high prevalence of rheumatic valve disease.[17]

Aortic stenosis is the most commonly acquired valvular disease. When it is severe and symptomatic, a surgical approach is the gold standard therapy. In this setting, risk scoring plays an important role, identifying high-risk patients who could benefit from a percutaneous approach. However, there are presently no specific scores for mortality prediction in transcatheter aortic valve implantation (TAVI). The current score models have modest accuracy, with C statistic values ranging from 0.59–0.71[22-24] to predict mortality after TAVI. An explanation of the current scores in this scenario is that they were developed within the parameters of a procedure that involves cardioplegia, sternotomy/thoracotomy, extracorporeal circulation, and other clinical characteristics that may not influence survival after TAVI.[25]

CONCLUSION

It is essential to remember that clinical judgement must always be taken into account as well as a valve specialist's and heart team's opinions. Cardiac surgery and percutaneous replacement are also improving, thus models developed based on the current techniques may become inadequate for effective risk verification in this particular class of patients. In summary, all the score systems may be used (Table 1) within the scope of valvular heart disease with varying accuracy and we recommend a local validation test before use.

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