Journal of Cardiovascular Disease Research
ISSN: 0975-3583, 0976-2833 VOL 12, ISSUE 07, 2021

EuroSCORE Versus EuroSCORE II in Evaluation of the Risk of Cardiac Surgery: Review Article

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ABSTRACT

Background: The EuroSCORE-II has been recently developed in an attempt to address the shortcomings of the original EuroSCORE models for contemporary cardiac surgery. The validations of the EuroSCORE-II have so far been positive. There is striking similarity between the two models however there are a number of key differences between the two in the EuroSCORE-II renal impairment has been split into categories rather than dichotomized, neurological dysfunction has been replaced with poor mobility and the level of dyspnea and diabetes are now included. Post-infarct septal rupture is no longer included and both the operation type and urgency have been re-classified.

Objective: Aim of review article to highlight EuroSCORE versus EuroSCORE II in evaluation of the risk of cardiac surgery.

Methods: The databases were searched for articles published in English in 3 data bases [PubMed – Google scholar- science direct] and Boolean operators (AND, OR, NOT) had been used such as [Cardiac Surgery AND EuroSCORE OR EuroSCORE II] and in peer-reviewed articles between 1994 and 2021.

Conclusions: EuroSCORE II had better predictive discrimination for operative mortality than EuroSCORE I, which greatly overestimated this risk. EuroSCORE II fared well compared with the risk of cardiac surgery. The inclusive nature of EuroSCORE II for numerous procedures provides more flexibility than the risk of cardiac surgery for complex procedures.

Keywords: Cardiac Surgery EuroSCORE**,** EuroSCORE II**.**

INTRODUCTION

EuroSCORE (European System for Cardiac Operative Risk Evaluation) is a risk model which allows the calculation of the risk of death after a heart operation. The model asks for 17 items of information about the patient, the state of the heart and the proposed operation, and uses logistic regression to calculate the risk of death **(1)**.

First published in 1999, the model has been adopted worldwide, becoming the most widely used risk index for cardiac surgery, and its use is believed to have contributed substantially to the improvement in the results of heart surgery seen at the beginning of the millennium. A new model - EuroSCORE II - was announced at the EACTS meeting in Lisbon on Monday 3 October 2011 and published in the European Journal of Cardiothoracic

Surgery in April 2012. The updated calculator is available online at the official EuroSCORE website[(2)].

Early reports on the usage of EuroSCORE II were encouraging, with evidence showing that it has substantially improved the calibration of the older models and at least maintained and perhaps further improved on the discriminatory power of the previous models [(2)].

Aim of review article to highlight EuroSCORE versus EuroSCORE II in evaluation of the risk of cardiac surgery.

METHODS

A search strategy has been performed to determine the related literature. Initially, the objective of review was identified: To highlight EuroSCORE versus EuroSCORE II in evaluation of the risk of cardiac surgery. Relevant keywords included: Cardiac Surgery EuroSCORE and EuroSCORE II.

The databases were searched for articles published in English in 3 data bases [PubMed – Google scholar- science direct] and Boolean operators (AND, OR, NOT) had been used such as [Cardiac Surgery AND EuroSCORE OR EuroSCORE II] and in peer-reviewed articles between 1994 and 2021, a 27-year date range was selected, and no language limitations, and filtered in selected data basis for the last 27 years, however, the range of time interval for researches is wide as there's scarcity of data on the particular reviewed, accurate and depth in the retrieved literature. Documents in a language apart from English have been excluded as sources for interpretation was not found. Papers apart from main scientific studies had been excluded: documents unavailable as total written text, conversation, conference abstract papers and dissertations.

Importance of Risk Scoring Systems:

Risk models are used for two main reasons. The first is that a risk model such as EuroSCORE allows the calculation of the risk of death before undertaking a heart operation. The importance of that is to serve as a guide to the clinician as well as the patient about the advisability of an operation by helping to weigh the risk against the benefits. The second reason is that it can be used as a method of quality control. By calculating the expected risk of deaths for a group of patients having heart operations, compared with the number of actual deaths. This comparison can be used as a measure of the quality of the performance of the hospital, unit, or surgeon in question [(1)].

Most existing prognostic tools have been developed to predict mortality only. Mortality is a reliable and clinically important outcome in cardiac surgery; however, there are other measures and other adverse outcomes that might be worth considering. One of these is readmission, which is an outcome with significant health and economic implications. Another important process outcome in cardiac surgery is prolonged length of stay in the intensive care unit (ICU) and in hospital [(3)].

EuroSCORE:

Operative mortality is a good measure of quality of cardiac surgical care, as long as patient risk factors are taken into consideration. EuroSCORE is a

method of calculating predicted operative mortality for patients undergoing cardiac surgery[(2)].

Nearly 20 thousand consecutive patients from 128 hospitals in eight European countries were studied. Information was collected on 97 risk factors in all the patients. The outcome (survival or death) was related to the preoperative risk factors. The most important, reliable, and objective risk factors were then used to prepare a scoring system. The scoring system was prepared from part of the database then tested and validated on another part. This scoring system is EuroSCORE [(1)].

An increasing number of European hospitals have tested EuroSCORE on their own patients in comparison to other scoring systems, and it is performing very well. Recently, the national British database was used to test EuroSCORE; it outperformed other simple scoring systems and approached Bayesian models in discrimination power [(1)].

The simple additive EuroSCORE model is now well established and has been validated in many patient populations across the world. It is easy to use, even at the bedside. It is very valuable in quality control in cardiac surgery and gives quite a useful estimate of risk in individual patients[(3)].

However, particularly in very high-risk patients, the simple additive model may sometimes underestimate the risk when certain combinations of risk factors co-exist. The full logistic version of EuroSCORE produces more accurate risk prediction for a particular high-risk patient. Its main disadvantage is that the risk has to be calculated in quite a complex way - not by mental arithmetic or "on the back of an envelope" [(2)].

EuroSCORE II:

Calculation of EuroSCORE II depends on several factors. These factors are related to the patient, the heart, or the operation as the following:

- ***Patient related factors:***

[1] Age: in completed years. Some of the weighting for age is now incorporated into the renal impairment risk factor, so it is important that all risk factors are entered to give reliable risk estimations. Of over 20,000 patients in the EuroSCORE database, only 21 patients were aged over 90 - therefore the risk model may not be accurate in these patients. The oldest patient in the EuroSCORE database was 95 - EuroSCORE II is not validated in patients over this age [(4)].

[2] The gender[(2)].

[3] Renal impairment: There are now 3 categories based on creatinine clearance calculated using Cockcroft-Gault formula. Unlike serum creatinine in the old EuroSCORE model, some of the weighting for age is directly incorporated into this factor, as age is a component of creatinine clearance. The 3 categories are:

- On dialysis (regardless of serum creatinine level).
- Moderately impaired renal function (50-85 ml/min).
- Severely impaired renal function (<50 ml/min) off dialysis [(1)].

Creatinine clearance (ml/min) = (140-age (years)) x weight (kg) x (0.85 if female) / [72 x serum creatinine (mg/dl)]

Weight (and creatinine) have not been directly included in the main EuroSCORE II calculator because they are not direct risk factors in the EuroSCORE II model, other than they contribute to creatinine clearance[1].

[4] Extracardiac arteriopathy: one or more of the following:

- Claudication.
- Carotid occlusion or >50% stenosis.
- Amputation for arterial disease.
- Previous or planned intervention on the abdominal aorta, limb arteries or carotids[4].

[5] Poor mobility: severe impairment of mobility secondary to musculoskeletal or neurological dysfunction[2].

[6] Chronic lung disease: long term use of bronchodilators or steroids for lung disease[2].

[7] Active endocarditis: patient still on antibiotic treatment for endocarditis at time of surgery[4].

[8] Critical preoperative state: ventricular tachycardia or ventricular fibrillation or aborted sudden death, preoperative cardiac massage, preoperative ventilation before anaesthetic room, preoperative inotropes or IABP, preoperative acute renal failure (anuria or oliguria <10ml/hr) [4].

[9] Diabetes on insulin[2].

Cardiac related factors:

[1] NYHA classification:

The New York Heart Association (NYHA) Functional Classification provides a simple way of classifying the extent of heart failure. It places patients in one of four categories based on how much they are limited during physical activity; the limitations/symptoms are in regard to normal breathing and varying degrees in shortness of breath and/or angina [5, 6].

It originated in 1928, when no measurements of cardiac function were possible, to provide a common language for physicians to communicate [7]. Despite difficulties in applying it, such as the challenge of consistently classifying patients in class II or III, because functional capacity is such a powerful determinant of outcome it remains arguably the most important prognostic marker in routine clinical use in heart failure today. With time the classification system evolved and updated multiple times. Presently, the ninth edition of the NYHA classification is being used in the clinical practice released in the year 1994 by the Criteria Committee of the American Heart Association, New York City Affiliate [7, 8].

The NYHA Classification system is a simple and widely used tool that classifies patients with heart failure into one of four classes according to their degree of symptoms at rest and with activity. In the early stages of heart failure, the heart may function adequately both at rest and with activity. With progression of the disease, the heart will first not be able to

meet the demands of the body with activity, and patients will begin to demonstrate clinical signs and symptoms with activity [8].

With further progression of the disease, patients will demonstrate signs and symptoms of heart failure even at rest. The NYHA Classification system is the system most commonly used by physicians to prognosticate and monitor the effectiveness of treatment interventions in heart failure [5].

The classes used in this system, I to IV with I am indicating less severity and higher numbers indicating greater severity. Classification is based on the patient's self-report of signs and symptoms. Patients can move between classes, either up or down, depending on the severity of their disease at the time[8].

The NYHA Classification system has been examined for its ability to predict mortality. With optimal treatment, there is a 1-year mortality of 10% to 15% for stable patients classified in NYHA class I and II, 15% to 20% for patients classified in class III, and 20% to 50% for patients classified in class IV[8].

The NYHA Classification system is often criticized because it only documents self-reported signs and symptoms and does not provide guidance for treatment interventions. Therefore, a new approach for heart failure classification was developed that emphasizes the appropriate treatment interventions, depending on the stage of the disease[5].

This system classifies patients into one of four stages, A to D, that can be used for selection of medical treatment interventions. Stage A includes patients with a high risk for developing left ventricular dysfunction, with the emphasis on risk factor modification as the treatment intervention[5].

Stage B includes patients with left ventricular dysfunction without any symptoms, with treatment interventions also focused on prevention. Stage C includes patients with left ventricular dysfunction and presenting symptoms. At stage C, medical and pharmacological interventions are recommended to alleviate symptoms and slow disease progression. Stage D is for those patients with advanced stage refractory heart failure[8].

At stage D, specialized pharmacological and surgical treatment interventions are recommended. With this staging system, once patients reach stage C or D and have symptoms, they cannot revert to stage A or B, indicating that although symptoms may be controlled with medications the disease is continuing to progress[5].

- **NYHA classification:**

I. No limitation of physical activity. Ordinary physical activity does not cause undue fatigue, palpitation, dyspnea (shortness of breath).

II. Slight limitation of physical activity. Comfortable at rest. Ordinary physical activity results in fatigue, palpitation, dyspnea (shortness of breath).

III. Marked limitation of physical activity. Comfortable at rest. Less than ordinary activity causes fatigue, palpitation, or dyspnea.

IV. Unable to carry on any physical activity without discomfort. Symptoms of heart failure at rest. If any physical activity is undertaken, discomfort increases[5].

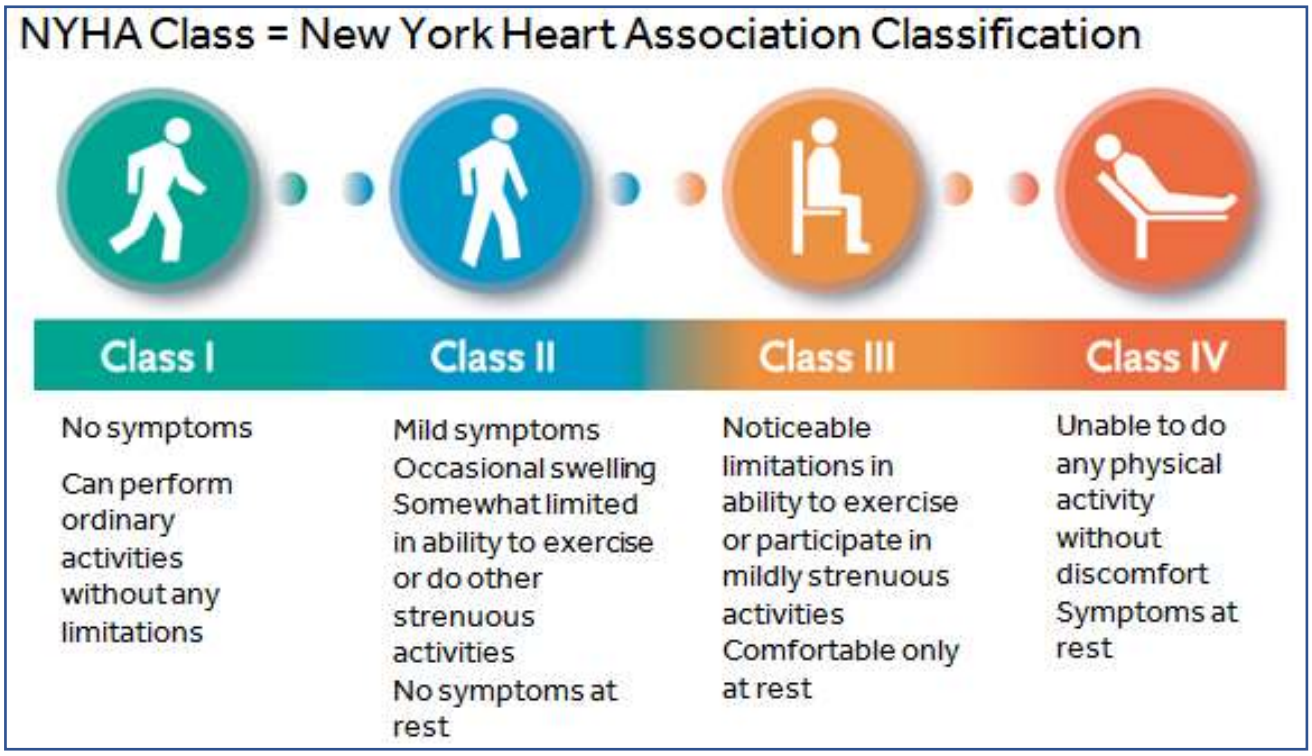

Figure (1): NYHA classification[5].

[2] Canadian Cardiovascular Society (CCS) angina score class 4 angina: angina at rest.

The CCS angina classification is a physician reported symptom severity scale used to assess and grade physical activity symptoms on 4 levels: class I indicates angina with strenuous exertion; class II indicates angina with walking >200 yards on flat surfaces, climbing stairs rapidly, or in cold or emotional situations; class III indicates angina with walking 100–200 yards on flat surfaces; and class IV indicates angina at rest or with any physical activity. CCS angina classification has been associated with coronary revascularization, myocardial infarction, cognitive impairment, and mortality in clinical trials and prospective registries [9].

[3] LV function:

Left ventricular dysfunction (LVD) is the most significant, non-acutely occurring, cardiac-related risk factor in the EuroSCORE system, and also one of the presumed objective parameters. However, on closer examination, the EuroSCORE definitions of cardiac dysfunction give cause for concern, as the methods of measurement may be far

less objective and accurate than hitherto accepted[4, 10].

[4] Recent MI: Myocardial infarction within 90 days [1].

[5] Pulmonary hypertension: systolic pulmonary artery pressure, now in 2 classes:

- Moderate: PA systolic pressure (31-55 mm Hg).
- Severe: PA systolic pressure (>55mm Hg) [1].

Operation related factors:

[1] Urgency: now four classes:

- Elective: routine admission for operation.
- Urgent: patients who have not been electively admitted for operation but who require intervention or surgery on the current admission for medical reasons. These patients cannot be sent home without a definitive procedure.
- Emergency: operation before the beginning of the next working day after decision to operate.
- Salvage: patients requiring cardiopulmonary resuscitation (external cardiac massage) in route to the operating theatre or prior to induction of anaesthesia. This does not include cardiopulmonary resuscitation following induction of anaesthesia[4].

[2] Weight of the intervention: include major interventions on the heart such as: CABG, valve repair or replacement, replacement of part of the aorta, repair of a structural defect, maze procedure, and resection of a cardiac tumour [1].

[3] Surgery on thoracic aorta [2].

The original version of the EuroSCORE was developed between 1995 and 1999 from a European database of more than 19,000 cardiac surgical patients, the majority of whom underwent coronary artery surgery and approximately a third of whom underwent valve surgery [11]. In the years after its publication, the EuroSCORE was widely accepted and implemented in Europe, North America, and Asia both to assess risk and to promulgate improved operative care for cardiac surgery patients. Over the course of the subsequent decade, however, advances in the practice of cardiac surgery caused EuroSCORE I to overestimate the risk of mortality for patients with low risk in actuality while underestimating the risk for high-risk patients [12].

Other drawbacks of the EuroSCORE included its failure to take liver function into account and its use of serum creatinine instead of clearance, which is a more accurate measure of renal function. The EuroSCORE was also found to substantially overestimate perioperative mortality risk in aortic valve replacement (AVR) patients. Owing to these limitations and disadvantages, in 2012 EuroSCORE was updated and revised as EuroSCORE II to make it applicable to a wider variety of surgical procedures and to incorporate fewer variables than

the EuroSCORE score, thereby making it easier to use. Still, some evidence exists that Euro-SCORE II may be inferior to EuroSCORE in estimating the risk of mortality [13].

CONCLUSION

EuroSCORE II had better predictive discrimination for operative mortality than EuroSCORE I, which greatly overestimated this risk. EuroSCORE II fared well compared with the risk of cardiac surgery. The inclusive nature of EuroSCORE II for numerous procedures provides more flexibility than the risk of cardiac surgery for complex procedures.

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