SCIENTIFIC LETTER

# The risk model of choice for coronary surgery in the UK

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Coronary bypass surgery is perhaps the most investigated surgical procedure[1] with clear end points for outcome such as operative mortality. Consequently, it has long been regarded as a sentinel operation for outcome.[2 3] Over 25 000 coronary bypass operations are performed per year in the UK and the operative mortality has reached a plateau in recent years of approximately 3%. The risk that an individual patient will not survive surgery depends on many factors, some of which can be quantified and form the basis of risk scoring systems.

Several risk stratification systems have developed over recent years with varying complexity, including those based on simple additive models such as Parsonnet,[4] EuroSCORE[5–7] and others.[8 9] More complex statistical algorithms using logistic regression[10 11] and Bayes modelling[8] also exist. The ideal model should have high predictive accuracy (ability to predict the proportion of patients who will have an adverse outcome), good discriminatory power (ability to identify which patients are likely to have an adverse outcome), as well as being simple and user-friendly. The aim of this study was to determine the most suitable risk model for coronary bypass surgery in the UK by testing five models on the National Adult Cardiac Surgical Database.

## PATIENTS AND METHODS

Data from 16 619 patients who underwent coronary bypass surgery were obtained from the UK National Adult Cardiac Surgical Database.[12] All cardiothoracic centres in the UK are invited to contribute data from their local systems to this database that is run on a central server using the Patient Analysis & Tracking System (PATS, Dendrite Clinical Systems Ltd, Playhatch, UK). The patients were risk stratified using two simple additive models (Parsonnet and EuroSCORE) and three Bayesian models (UK, US merged cardiac registry (MCR), and EuroSCORE Bayesian). The predictive accuracy of these scoring systems was tested by comparing actual and predicted mortality. Discriminatory power was assessed using receiver operating characteristic (ROC) curves.[13] An area of 1.00 under the ROC curve indicates perfect discrimination whereas an area of 0.50 indicates complete absence of discrimination. Any intermediate value is a quantitative measure of the ability of the risk predictor to distinguish between survivors and non-survivors.

## RESULTS

The actual mortality was 3.12% (95% confidence interval 2.86% to 3.38%). Parsonnet predicted 5.26%, EuroSCORE additive 2.98%, MCR Bayesian 2.06%, UK Bayesian 3.24%, and EuroSCORE Bayesian 3.23%. Thus the Parsonnet model significantly overpredicted and the MCR model underpredicted mortality. The areas under the ROC curve were as follows: Parsonnet 0.69, EuroSCORE additive 0.74, MCR Bayesian 0.74, UK Bayesian 0.75, and EuroSCORE Bayesian 0.75 (table 1). With the exception of the Parsonnet score, all models performed well in discriminatory power, with the EuroSCORE additive model performing as well as the more complex Bayesian models.

## DISCUSSION

Cardiac surgical risk assessment is important to patients, cardiologists, and cardiac surgeons, and should form part of clinical decision making and informed consent. There are many risk stratification models applicable to outcome for coronary artery bypass surgery. Simple additive models offer the possibility of calculating risk at the bedside, or in an outpatient department mentally, or "on the back of an envelope". More complex risk models may be more accurate for specific small subgroups of patients. Very high risk patients, for example, are better served by the use of full logistic models. The EuroSCORE logistic model, for example, has a risk calculator which can be downloaded from the website (www.euroscore.org) but its complex formula, though easily worked out by computer, cannot be applied at the bedside without one. This may discourage hospitals and units with limited audit and information technology resources from performing risk assessment, to the detriment of clinical decision making. In the current political climate, some form of risk assessment is mandatory, not only for surgical decision and informed consent, but also as a basic standard by which quality monitoring of surgical outcomes may be judged. We have tested various risk models on the National Adult Cardiac Surgery Database and found that more complex models offer little advantage over an effective simple additive system. We recommend the use of the simple additive EuroSCORE model for predicting operative mortality after coronary artery bypass surgery in the UK.

**Table 1** Area under the receiver operating characteristic (ROC) curve for five risk models

| Risk model | Area under ROC curve | Standard error | Confidence limits (95%) | |
|---|---|---|---|---|
| | | | Lower | Upper |
| Parsonnet | 0.693 | 0.012 | 0.669 | 0.716 |
| EuroSCORE additive | 0.743 | 0.011 | 0.721 | 0.765 |
| MCR Bayesian | 0.740 | 0.011 | 0.718 | 0.761 |
| UK Bayesian | 0.754 | 0.011 | 0.733 | 0.775 |
| EuroSCORE Bayesian | 0.753 | 0.011 | 0.731 | 0.775 |

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# IMAGES IN CARDIOLOGY

## Imaging of a huge atrial myxoma

A 71 year old woman with progressive dyspnoea and exercise intolerance was found during a transthoracic echocardiography to have a huge mobile mass in the left atrium. Tentative diagnosis of left atrial myxoma was made and the patient was referred to our hospital for further evaluation and treatment.

A transoesophageal echocardiogram (upper panel, left) revealed a solid, round, and homogeneous tumour tending to prolapse through the mitral valve during diastole. An angiogram of the right pulmonary artery in the levophase (lower panel, left) showed the left heart structures and the mass (arrowheads). These findings were confirmed by magnetic resonance imaging (below, still frame of a steady state free precession (SSFP) cine sequence in the vertical long axis) (Ao, aorta; LA, left atrium; LV, left ventricle; MV, mitral valve; Myx, myxoma; PV, pulmonary veins; RA, right atrium; RV, right ventricle).

The patient was taken to the operating room for extirpation of the atrial tumour. A solid, round mass with a non-mobile surface was removed (upper and lower panels, right). The patient's recovery was unremarkable. Anatomo-pathology confirmed the diagnosis of myxoma.

Myxoma is the most common type of primary cardiac tumour, and approximately 85% of myxomas develop in the left atrium. Typically two distinct types of myxoma can be identified: round type characterised by a solid and round shape with a non-mobile surface; and polypoid type characterised by an irregular and soft shape with a mobile and friable surface. The latter characteristics are predictors of systemic embolism.

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