

# EuroSCORE Predicts Mid-Term Outcome after Combined Valve and Coronary Bypass Surgery

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**Background and aim of the study:** EuroSCORE is widely used to assess operative risk. Combined cardiac procedures carry increased perioperative mortality, but the influence of preoperative factors on mid-term outcome is not well known for these patients. The study aim was to determine if EuroSCORE risk influences mid-term survival after combined coronary artery bypass grafting (CABG) and valve surgery.

**Methods:** Follow up (mean 23.7 months) was obtained in 258 consecutive hospital survivors (148 males, 110 females; median age 72.29 years; mean EuroSCORE 7 points) operated on between January 1998 and March 2001. CABG + aortic valve replacement (AVR) was performed in 171 patients, CABG + mitral surgery in 72, and CABG + double valve surgery in 15. Kaplan-Meier estimates were calculated for survival and combined freedom from death and NYHA class III/IV. The Cox regression model was applied to prove the influence of EuroSCORE risk

The combination of coronary artery bypass grafting (CABG) and valve replacement or repair generally increases perioperative mortality and decreases long-term survival. Additionally, the patient spectrum has been shifted from low-risk patients without comorbidity to high-risk patients with an accumulation of cardiac and non-cardiac comorbidities. Surgical risk assessment is of specific interest, especially in high-risk patients. The predictors of early mortality in combined CABG and valve surgery (1-5), as well as in isolated interventions (6-8), are well documented.

and a number of preoperative and operative variables on mid-term outcome.

**Results:** Thirty patients (11.63%) died during follow up, and 34 (13.17%) were in NYHA class III/IV. Freedom from death and NYHA class III/IV was 89.3%, 74.7% and 55.2% at 12, 24 and 36 months, respectively. The significant predictor for combined death and NYHA class III/IV was EuroSCORE risk ( $p = 0.0004$ ). In the subgroup of patients with CABG + mitral valve surgery, age was identified as a significant risk factor for death ( $p = 0.0346$ ), whereas in the subgroup of patients with CABG + AVR EuroSCORE was detected as significant risk factor for combined death and NYHA class III/IV.

**Conclusion:** EuroSCORE is an important predictor for poor mid-term outcome after combined CABG and valve surgery.

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However, the impact of preoperative and operative factors on postoperative morbidity and mid-term outcome is not well known in patients undergoing combined cardiac procedures.

The EuroSCORE database is a risk system which includes pooled information on cardiac patients from several European countries obtained during the 1990s (9,10). In the comparison of different score systems, EuroSCORE had the highest predictive value with regard to perioperative mortality (11,12).

The study aim was to determine if EuroSCORE risk and a number of preoperative and operative variables influence mid-term survival after combined CABG and valve surgery.

## Clinical material and methods

### Patients

A total of 258 consecutive patients (148 males, 110 females) who had undergone combined CABG and

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Table I: Patient characteristics and operative data.

Variable	Value
No. of patients	258
Age (years)*	72.29 ± 9.9
Gender ratio (M:F)	148:110
EuroSCORE*	7.06 ± 2.68
LVEF >50%	187
LVEF ≤50%	71
CABG + AVR	171
CABG + MV replacement	6
CABG + MV repair	66
CABG + AVR + MV surgery	15
Aortic valve prosthesis size	
19, 21	81
23, 25, 27, 29	105
No. of bypass grafts	
1	113
2	79
3	66

\*Values are mean ± SD.

AVR: Aortic valve replacement; CABG: Coronary artery bypass grafting; LVEF: Left ventricular ejection fraction; MV: Mitral valve.

valve surgery between January 1998 and March 2001 at the authors' institution, and all of whom were hospital survivors, were included in the study. Perioperative deaths were excluded. Among the patients, 171 had undergone CABG + aortic valve replacement (AVR), and 71 had undergone CABG + mitral valve surgery (66 mitral valve repairs, six mitral valve replacements (MVR)). In addition, 15 patients underwent CABG + double valve surgery. In patients with AVR, small-sized prostheses (19 or 21 mm) had been implanted in 81 patients, and larger-sized prostheses (23, 25, 27 and 29 mm) in 105 patients. Single-vessel revascularization was performed in 113 patients, double-vessel in 79, and three or more grafts were used in 66 patients. The mean patient age at the time of surgery was 72.3 ± 9.9 years (range: 67 to 94 years). Preoperatively, 187 patients had a normal left ventricular function (ejection fraction >50%), and 71 showed left ventricular

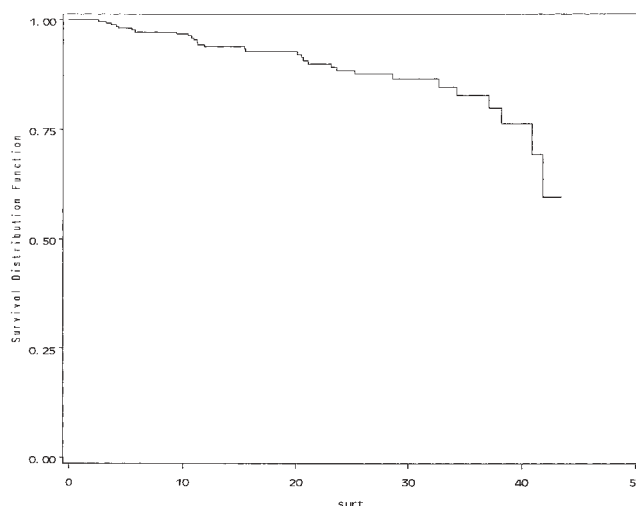


Figure 1: Kaplan-Meier estimation of survival.

dysfunction (ejection fraction ≤50%). None of the patients was in an emergency status. The EuroSCORE ranged from 4 to 15, with a median of 7 (Table I).

### Follow up

Clinical follow up was obtained by standard questionnaire mailed to patients and their physicians, or by direct telephone contact with regard to NYHA functional class, occurrence of angina pectoris, shortness of breath, and postoperative valve-related complications.

### Statistical analysis

Kaplan-Meier estimates were calculated for survival and combined freedom from death and NYHA class III/IV. The Cox regression model was applied to prove the influence of EuroSCORE risk and a number of other preoperative and operative variables (age, left ventricular function, number of bypass grafts, small size of the implanted valve prostheses in AVR) on mid-term outcome. Model results are described with hazard ratios, corresponding 95% confidence intervals (CI) and p-values. All tests were two-sided, and a p-value <0.05 was considered statistically significant.

Table II: Independent predictors for death and NYHA class III + IV (all patients).

Variable	Hazard ratio	95% CI	p-value
No. of bypass grafts	1.132	0.818-1.567	0.4549
MV surgery	0.858	0.303-2.431	0.7736
AV surgery	0.767	0.446-1.322	0.3400
EuroSCORE	1.178	1.077-1.289	0.004

AV: Aortic valve; MV: Mitral valve.

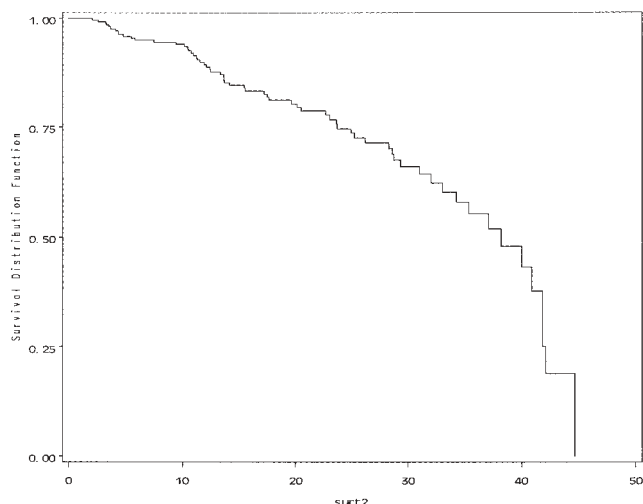


Figure 2: Kaplan-Meier estimation of NYHA class III/IV or death.

## Results

The median follow up was 23.7 months (range: 2.6 to 43.5 months). During the follow up period, 30 patients (11.63%) died; among these were 19 patients with CABG + AVR, nine with CABG + MVR, and two with CABG + double valve replacement. Kaplan-Meier analysis showed freedom from death as 93.8%, 88.4% and 82.7% at 12, 24 and 36 months, respectively (Fig. 1). At the end of follow up, 228 patients (88.37%) were alive, amongst whom 190 patients (83.33%) were in NYHA class I/II and 34 (13.17%) were in NYHA class III/IV. The NYHA class could not be determined in four patients due to uncompleted questionnaires. Freedom from combined death and NYHA class III/IV was 89.3%, 74.7% and 55.2% at 12, 24 and 36 months, respectively (Fig. 2).

Cox regression analysis including all patients revealed EuroSCORE ( $p = 0.0004$ ) as the only significant independent predictor for combined death and NYHA class III/IV (Table II). In the subgroup of patients undergoing CABG + AVR, EuroSCORE ( $p = 0.0021$ ) was also identified as an independent predictor for combined death and NYHA class III/IV (Table III).

However, in the subgroup of patients undergoing CABG + MVR, EuroSCORE was not predictive for death or poor NYHA functional class. Here, Cox regression analysis identified only age as a significant risk factor ( $p = 0.0346$ ) for death (Table IV).

## Discussion

Scoring systems have become important tools in medical quality control and in the performance analysis of surgical units. They may also gain increasing relevance for cost-benefit analyses. The risk assessment of perioperative mortality has become well established as risk score systems such as the EuroSCORE have been introduced. The EuroSCORE system, which was designed primarily to estimate perioperative mortality, is based on patient-related factors, cardiac-related factors and operation-related factors, respectively, and includes pooled information on cardiac patients from several European countries (9,10). It is often suggested that patients undergoing combined cardiac surgery have, in general, an increased risk for perioperative mortality and complications, as well as longer postoperative hospital stays (4,5). The predictors for early mortality using the EuroSCORE are well documented (8-10,13,14). Indeed, recent studies comparing several risk score systems have revealed the EuroSCORE to be the system with the highest predictive value (11,12,15).

In contrast, the effect of preoperative risk factors on mid- to long-term outcome is much less well defined. The purpose of the present study was to test whether a preoperative simple additive EuroSCORE could be used to estimate the risk for poor outcome in the mid-term in a high-risk patient population with combined valve surgery and CABG.

In this study, the influence of the additive EuroSCORE and a number of independent preoperative and operative factors on mid-term survival and functional outcome in patients undergoing combined coronary and valve surgery was evaluated. Freedom from the combined end-point of death or NYHA class III/IV was 89.3%, 74.7% and 55.2% at 12, 24 and 36 months, respectively. An increasing EuroSCORE risk was identified as the sole important predictor for poor

Table III: Independent predictors for death and NYHA class III + IV; patients undergoing CABG + aortic valve replacement.

Variable	Hazard ratio	95% CI	p-value
Diameter of AV-prosthesis	1.110	1.743-1.660	0.6101
No. of bypass grafts	1.107	0.740-1.655	0.6214
EuroSCORE	1.200	1.068-1.348	0.0021

AV: Aortic valve.

Table IV: Independent predictor for death; subgroup of patients undergoing CABG + mitral valve surgery.

Variable	Hazard ratio	95% CI	p-value
EuroSCORE	1.106	0.874-1.399	0.4015
No. of bypass grafts	1.683	0.780-3.631	0.1849
Age	1.093	1.006-1.187	0.0346

outcome within three years. This was markedly in excess to the rates reported for mid-term outcome of patients with isolated CABG or valve operations (16-18). Patients undergoing CABG and mitral valve surgery carry a higher risk for perioperative mortality as well as for poor late-term outcome when compared to combined CABG and AVR (4,5). Patients who have ischemic mitral valve disease - which is itself an important risk factor - are generally older, have greater cardiac structural damage, and therefore have less cardiac reserve than patients undergoing isolated CABG. In the present study, multivariate analysis of the subset of patients who underwent mitral valve surgery and CABG identified only age as an independent risk factor with regard to late mortality. In the subgroup of patients who underwent CABG + AVR, again EuroSCORE strongly predicted the combined event of death and NYHA class III/IV.

### Study limitations

The primary limitation was that this was a single-institution experience, despite patients being operated on within a short time period, using the most recently developed surgical techniques. The second limitation was that, although EuroSCORE was developed to estimate perioperative risk, it is a general reflection of the patient's age and morbidity. In the present study, only hospital survivors were considered, thereby removing patients who had died perioperatively and for whom the score was actually developed. Nevertheless, the results obtained showed that EuroSCORE may be useful also to predict the patients' mid-term outcome.

A third limitation was that a simple additive system was used to obtain the Euroscore. Traditionally, patients with combined CABG and valve procedures represent a high-risk population, and this was also reflected by the increased number of patients in the study with a EuroSCORE above 5 and a mean score of 7. EuroSCORE has been found to underestimate the operative mortality of high-risk patients (16); therefore, use of the full logistic equation to obtain EuroSCORE instead of the simpler additive system was suggested to offer certain advantages in predicting high-risk patients. However, the EuroSCORE project group showed the simple additive system to be the 'gold standard' of risk assessment (17).

A fourth - and perhaps most important - factor was that the subset analysis may have been hampered by small patient numbers, especially in the group with combined mitral surgery and CABG, where EuroSCORE did not emerge as a predictive factor for poor outcome.

*It is concluded* from these data that EuroSCORE is an important predictor for poor mid-term outcome after combined CABG and valve surgery. In homogeneous subgroups it is also an indicator of comorbidities, and thus comorbidities appear to be the major determinants of mid-term outcome. EuroSCORE can be used as a simple tool not only to assess the operative risk of these high-risk patients but also to identify those patients who are at increased risk of premature death or heart failure after surgery. Therefore, conservative medical efforts can be focused more on these patients to identify strategies for outcome improvement.

### References

1. Akins CW, Buckley MJ, Daggett WM, Hilgenberg AD, Austen WG. Myocardial revascularization with combined aortic and mitral valve replacements. *J Thorac Cardiovasc Surg* 1985;90:272-277
2. Kirklin JK, Naftel DC, Blackstone EH, Kirklin JW, Brown RC. Risk factors for mortality after primary combined valvular and coronary artery surgery. *Circulation* 1989;79(Suppl.I):I-185-I-190
3. Karp RB, Mills N, Edmunds H, Jr. Coronary artery bypass grafting in the presence of valvular disease. *Circulation* 1989;79(Suppl.I):I-182-I-184
4. Flameng W, Szecsi J, Sergeant P, Daenen W, Herijgers P, Scheys I. Combined valve and coronary artery bypass surgery: Early and late results. *Eur J Cardiothorac Surg* 1994;8:410-419
5. Herlitz J, Brandrup-Wognsen G, Caidahl K, et al. Mortality and morbidity among patients who undergo combined valve and coronary artery bypass surgery. Early and late results. *Eur J Cardiothorac Surg* 1997;12:836-846
6. Edwards FH, Clark RE, Schwartz M. Coronary artery bypass grafting: The Society of Thoracic Surgeons National Database experience. *Ann Thorac Surg* 1994;57:12-19
7. Edwards FH, Grover FL, Shroyer AL, Schwartz M,

- Bero J. The Society of Thoracic Surgeons National Cardiac Surgery Database: Current risk assessment. *Ann Thorac Surg* 1997;63:903-908
8. Roques F, Nashef SAM, Michel P, and the EuroSCORE study group. Risk factors for early mortality after valve surgery in Europe in the 1990s: Lessons from the EuroSCORE pilot program. *J Heart Valve Dis* 2001;10:572-578
  9. Nashef SAM, Roques F, Michel P, Gauducheau E, Lemershow S, Salamon R and the EuroSCORE study group. European System for cardiac operative risk evaluation (EuroSCORE). *Eur J Cardiothorac Surg* 1999;16:9-13
  10. Roques F, Nashef SAM, Gauducheau E, et al. Risk factor and outcome in European cardiac surgery: Analysis of the EuroSCORE multinational database of 19030 patients. *Eur J Cardiothorac Surg* 1999;15:816-823
  11. Geissler HJ, Hölzl P, Marohl S, et al. Risk stratification in heart surgery: Comparison of six score systems. *Eur J Cardiothorac Surg* 2000;17:400-406
  12. Kurki TS, Järvinen O, Kataja MJ, Laurikka J, Tarkka M. Performance of three preoperative risk indices; CABDEAL, EuroSCORE and Cleveland models in a prospective coronary bypass database. *Eur J Cardiothorac Surg* 2002;21:406-410
  13. Stoica SC, Sharples LD, Ahmed I, Roques F, Large SR, Nashef S. Preoperative risk prediction and intraoperative events in cardiac surgery. *Eur J Cardiothorac Surg* 2002;21:41-46
  14. Gürler S, Gebhard A, Godehardt E, Boeken U, Feindt P, Gams E. EuroSCORE as a predictor for complications and outcome. *Thorac Cardiovasc Surg* 2003;51:73-77
  15. Asimakopoulos G, Al-Ruzzeh S, Ambler G, et al. An evaluation of existing risk stratification models as a tool for comparison of surgical performances for coronary artery bypass grafting between institutions. *Eur J Cardiothorac Surg* 2003;23:935-942
  16. Sergeant P, Blackstone E, Meyns B. Leuven Coronary Surgery Program. Validation and interdependence with patient-variables of the influence of procedural variables on early and late survival after CABG. *Eur J Cardiothorac Surg* 1997;12:1-19
  17. Turina J, Milincic J, Seifert B, Turina M. Valve replacement in chronic aortic regurgitation. True predictors of survival after extended follow-up. *Circulation* 1998;98:II-100-II-107
  18. Haraphongse M, Na-Ayudhya RK, Williams R, et al. Long term clinical outcomes following isolated mitral valve replacement. *Can J Cardiol* 1993;9:417-422
  19. Sergeant P, De Worm E, Meyns B. Single centre, single domain validation of the EuroSCORE on a consecutive sample of primary and repeat CABG. *Eur J Cardiothorac Surg* 2001;20:1176-1182
  20. Michel P, Roques F, Nashef SAM, The EuroSCORE Project Group. Logistic or additive EuroSCORE for high-risk patients? *Eur J Cardiothorac Surg* 2003;23:684-687