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Prognostic value of preoperative quality of life on mortality after isolated elective myocardial revascularization

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Abstract

OBJECTIVES: This study evaluates whether a low preoperative quality of life (QoL), measured with the EuroQoL instruments EQ-5D and EQ-visual analogue scale (VAS) can be used as a predictor of mortality after elective isolated myocardial revascularization.

METHODS: A total of 2501 patients, with a mean age of 65.3 ± 9.4 (range 18–93) years and a mean additive EuroSCORE of 2.7 ± 2.1 (0–12), undergoing an elective isolated coronary artery bypass graft between January 2002 and June 2011 completed preoperative EQ-5D and EQ-VAS.

RESULTS: Hospital mortality [1.0% (25/2501 patients)] and 30-day mortality [1.2% (29/25 patients)] were the studied outcomes. The EQ-5D was 0.69 ± 0.26 (−0.30 to 1.0) with a median of 0.77 and the EQ-VAS was 59.7 ± 22.4 (0–100) with a median of 60. Regression analysis showed a significant correlation between hospital mortality and EQ-5D ($P = 0.016$) and EQ-VAS ($P = 0.033$). There is a significant correlation between 30-day mortality and EQ-5D ($P = 0.048$), but not for EQ-VAS ($P = 0.06$). The c-statistics (95% confidence interval) for EQ-5D and EQ-VAS for predicting hospital mortality are 0.36 (0.24–0.46) and 0.33 (0.23–0.42), respectively. The c-statistics for predicting 30-day mortality are 0.39 (0.30–0.49) for EQ-5D and 0.35 (0.26–0.44) for EQ-VAS.

CONCLUSIONS: Based on these results, we conclude that, in isolation, poor low preoperative EQ-5D and EQ-VAS scores do not contribute to deciding which patients should undergo cardiac surgery.

Keywords: Quality of life • Coronary artery bypass graft • Mortality

INTRODUCTION

A patient's mortality risk from a procedure is an important parameter in making a clinical decision on whether to go through with the procedure or not. It is known that there is a correlation between preoperative quality of life (QoL) and post-surgical recovery in patients undergoing cardiac surgery [1–3]. Some research has shown that preoperative QoL, or an aspect of the QoL, can be used as an independent risk factor to predict post-surgical mortality and morbidity, certainly because the correlation between preoperative anginal class and preoperative QoL is low [4–7]. These results raise the question whether a cardiac surgical procedure can be denied for patients with a low preoperative QoL.

The aim of the present study is to evaluate whether preoperative QoL, using the EuroQoL [8], can be used to predict the risk of mortality for patients undergoing isolated elective coronary artery bypass graft (CABG) surgery.

PATIENTS AND METHODS

Patients

From our Coronary Surgery Database Radboud Hospital (CORRAD)—a database that stores pre-, peri- and postoperative data plus follow-up data from all adult patients undergoing cardiac surgery at the Radboud University Nijmegen Medical Centre (UMCN)—we identified 4107 patients who underwent isolated CABG between January 2002 and June 2011. Of the 4107, 3330 surgeries were elective and 2501 of these patients completed our preoperative EuroQoL-questionnaire on the day before surgery. The initial EuroSCORE [9] was used for risk stratification.

Follow-up

Patients who were discharged alive from the UMCN were seen at the postoperative outpatient clinic 6 weeks after discharge. Patients who did not show up were contacted by one of the authors (L.N.) to complete their 30-day survival data.

Quality of life

To assess the QoL, the EQ-5D and EQ-VAS, both components of the EuroQoL instrument, were used [8]. The EQ-5D consists of five domains of health (mobility, self-care, usual activities, pain/discomfort and anxiety/depression), and each domain is divided into three levels: (i) no problems, (ii) some or moderate problems and (iii) extreme problems. Based on the response to this

classification, a single index value is estimated using a general population-based algorithm [10]. Secondly, patients estimated their own health on a visual analogue scale (EQ-VAS) ranging from 0 to 100, with 0 being the worst possible health state and 100 being the best possible health state. The EQ-5D index can be regarded as a societal-based composite global QoL measure, whereas the EQ-VAS is a direct global QoL assessment from the patient's perspective.

All patients participated on a voluntary basis in this QoL research. Registration of data in the CORRAD database and the use of this information for research have been approved by the local ethical and research council of the Radboud University, Nijmegen [11].

Outcome variables

Study endpoints are hospital mortality, defined as death occurring at any time during hospital admission after CABG surgery, and 30-day mortality, defined as all hospital mortalities and all deaths within 30 days postoperation in the group of patients who were discharged from the UMCN before the 30th post-surgical day.

Statistical analyses

Statistical analyses were performed using 16.0 SPSS Inc., Chicago, IL, USA. Baseline characteristics are presented as a percentage for dichotomous variables, as mean ± SD, and as a range for numerical variables. Results from the EQ-5D and EQ-VAS are completed with a median and the 25th and 75th percentiles interquartile range (IQR range). Differences in percentages were tested using the χ^2 test and numerical variables were tested using the *t*-test or Mann–Whitney test when appropriate. The association between the EQ-5D, EQ-VAS and hospital or 30-day mortality is evaluated using logistic regression analysis. The Nagelkerke R^2 (0–100%) was used to evaluate the association between the EQ-5D and EQ-VAS. Receiver operator characteristic curves (ROC curves) were used to assess the value of EQ-5D and EQ-VAS as a predictor of hospitalisation or 30-day mortality. Only patients with complete data from all pre- and post-operative questionnaires were included in the analyses. A *P*-value of ≤0.05 was considered significant.

RESULTS

Patients

Between January 2002 and June 2011, 4107 isolated myocardial revascularizations were performed at the UMCN, with a hospital mortality of 70 patients (1.7%). After excluding urgent and emergency surgery, plus patients with a recent myocardial infarction as defined by the EuroSCORE [9], we identified 3330 patients who underwent isolated elective CABG (total population). Of these patients, 2501 (75%) had complete QoL data, our study population, 829 patients without or with incomplete QoL data were excluded, the exclusion group.

Table 1 presents the baseline characteristics of the total group, the study population and the exclusion group. Diabetes is defined as diet-controlled, oral therapy or insulin-dependent

Table 1: Baseline characteristics of patients

Variable	Total group [*n* = 3330 (%)]	Study population [*n* = 2501 (%)]	Excluded group [*n* = 829 (%)]	*P*-value*
Age (years)	65.5 ± 9.7 (18–93)	65.3 ± 9.4 (18–93)	66.4 ± 10.2 (35–91)	0.011
Female	753 (22.6)	525 (21.0)	228 (27.8)	0.001
Diabetes	735 (22.1)	542(21.7)	193 (23.1)	0.333
Vascular disease	525 (15.8)	391 (15.6	134 (16.3)	0.717
Neurological disease	298 (8.9)	226 (9.0)	72 (8.7)	0.759
Renal disease	92 (2.8)	68 (2.7)	24 (2.9)	0.789
Pulmonary disease	380 (11.4)	281 (11.2)	99 (11.9)	0.579
Preoperative myocardial infarction	1101 (33.1)	836 (33.4)	265 (32.0)	0.439
Previous cardiac surgery	116 (3.5)	86 (3.4)	30 (3.6)	0.823
Body mass index (kg/m^2)	27.4 ± 4.0 (17.5–48.2)	27.5 ± 4.1 (17.5–48.2)	27.1 ± 4.1 (17.5–47.6)	0.555
Additive EuroSCORE	2.8 ± 2.2 (0–12)	2.7 ± 2.1 (0–12)	3.1 ± 2.3 (0–12)	0.001
Groups				0.002
Low risk	1545 (46.4)	1197 (47.9)	348 (42.0)	
Medium risk	1353 (40.6)	1003 (40.1)	350 (42.2)	
High risk	432 (13.0)	301 (9.0)	131 (15.8)	
Three-vessel disease	2465 (74)	1859 (74.3)	606 (73.1)	0.747
Extracorporeal circulation (min)	100 ± 31 (11–359)	100 ± 31.8 (11–310)	99 ± 33.2 (27–359)	0.965
Aortic cross-clamp time (min)	59 ± 20 (6–187)	60 ± 21.8 (7–187)	59.6 ± 22.8 (6–166)	0.886
Off pump	235 (7.1)	181 (7.2)	54 (6.4)	0.481
Grafts (number)	1.9 ± 0.4 (1–4)	1.9 ± 0.44 (1–4)	1.9 ± 0.46 (1–4)	0.348
Distal anastomoses (number)	3.7 ± 1.2 (1–9)	3.6 ± 1.2 (1–9)	3.7 ± 1.2 (1–8)	0.186
EQ-5D		0.69 ± 0.26 (–0.30 to 1.0); 0.77 IQR: 0.65–0.84		
EQ-VAS		59.7 ± 22.4 (–0 to 100); 60 IQR:50–75		
Hospital mortality	36 (1.1)	25 (1.0)	11 (1.3)	0.430
30-day mortality	41 (1.2)	29 (1.2)	12 (1.4)	0.515

**P*-value study population versus exclusion group.

Table 2: Age, additive EuroSCORE, EQ-5D and EQ-VAS of hospital deaths versus hospital survivors

Variable	Survivors (n = 2476)	Hospital deaths (n = 25)	P-value
Age	65.3 ± 9.4	72.3 ± 7.9	0.001
EuroSCORE	2.7 ± 2.1	5.2 ± 2.7	0.001
EQ-5D	0.70 ± 0.26 (−0.30 to 1); 0.77 IQR 0.65–0.84	0.57 ± 0.31 (−27 to 0.89); 0.68 IQR 0.25–0.80	0.048
EQ-VAS	59.8 ± 22.5 (0–100); 60 IQR 50–75	50.1 ± 17.4 (20–95); 50 (IQR 39–60)	0.011
	Survivors (n = 2472)	30-day deaths (n = 29)	
Age	65.3 ± 9.4	72.3 ± 7.9	0.001
EuroSCORE	2.7 ± 2.1	5.2 ± 2.7	0.001
EQ-5D	0.70 ± 0.26 (−30 to 10); 0.77 IQR 0.65–0.84	0.60 ± 0.31 (−27 to 0.89); 0.69 IQR 40–82	0.090
EQ-VAS	59.8 ± 22.5 (0–100); 60 (50–75)	51.1 ± 17.4 (20–95); 50 (40–61)	0.021

diabetes; vascular disease as peripheral, abdominal vascular pathology or operation; and neurological disease as cerebrovascular accidents and/or transient ischaemic attack. Patients with a preoperative creatinine ≥150 µmol/l, preoperative dialysis or a renal transplant were registered under renal disease, and for pulmonary diseases the same definition has been used as applied by the EuroSCORE [9].

The study population has a mean age of 65.3 ± 9.4 (range 18–93) years. The EQ-5D is 0.69 ± 0.26 (−0.30 to 1.0), median of 0.77 (IQR 0.65–0.84) and the EQ-VAS is 59.7 ± 22.4 (0–100), median of 60 (IQR 50–75). The mean additive EuroSCORE is 2.7 ± 2.1 (0–12). Hospital mortality was 1.0% (25/2501 patients) and 30-day mortality was 1.2% (29/25). Statistical analysis shows that the exclusion group is significantly older (P = 0.0110), consists of more women, 27.8 versus 21% (P = 0.001), has a significantly higher percentage of high-risk patients, 15.8 versus 9% (P = 0.002), and has a significantly higher additive EuroSCORE risk score, 3.1 ± 2.3 (0–12) versus 2.7 ± 2.1 (0–12) (P = 0.001). Other studied variables show no statistically significant difference.

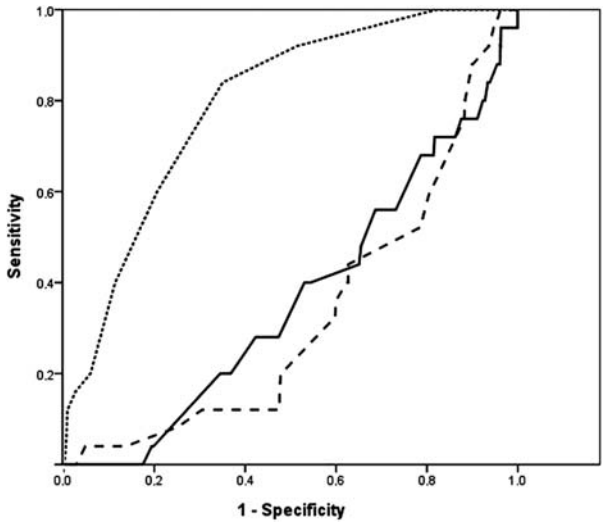

Figure 1: ROC curve for EQ-5D (full line), EQ-VAS (dotted line) and additive EuroSCORE (dashed line) for hospital mortality.

QoL and mortality

Table 2 presents the values of EQ-5D, EQ-VAS, the additive EuroSCORE and the age of hospital survivors versus hospital deaths for both 30-day survivors and 30-day deaths. Patients who died either during hospital admission or within 30-day post-surgery were significantly older than survivors (P = 0.001). In addition, the additive EuroSCORE is significantly higher for patients who died (P = 0.001), whereas the value of the EQ-5D is lower in the group of hospital deaths (P = 0.048). The EQ-VAS is significantly lower for both hospital and 30-day deaths (P = 0.011 and P = 0.021, respectively).

The association between the EQ-5D, EQ-VAS and hospital mortality is significant but very low; EQ-5D (P = 0.016; R^2 = 0.020), EQ-VAS (P = 0.033; R^2 = 0.016). The association between EQ-5D and EQ-VAS and 30-day mortality is significant for EQ-5D (P = 0.048; R^2 = 0.012), but not for EQ-VAS (P = 0.06; R^2 = 0.011). Both associations have a low correlation.

The c-index (95% confidence interval) for EQ-5D, EQ-VAS and the additive EuroSCORE for predicting hospital mortality are 0.36 (0.24–0.46), 0.33 (0.23–0.42) and 0.80 (0.71–0.87), respectively (Fig. 1). The c-index for predicting 30-day mortality is 0.39 (0.30–0.49) for EQ-5D and 0.35 (0.26–0.44) for EQ-VAS.

DISCUSSION

Several research groups have focused on various QoL assessments to test the predictive value for short- and long-term mortality of patients undergoing cardiac surgery [1–7]. In the present study, we took a closer look at the predictive value of EQ-5D and EQ-VAS, both components of the EuroQoL facility [8]. In our study population, only isolated elective CABG patients were included. Patients with urgent and emergency surgeries were excluded from our analyses as the medical indication for cardiac surgery in these cases is strictly regulated. Patients with a recent myocardial infarction, as defined by the EuroSCORE [9], were excluded. For some of these patients, the medical indication was decisive to perform a CABG and it was impossible to distinguish these specific patients in our database. From the 3330 patients (total population) who could be included in our study, 2501 (75%) had complete QoL data. The remaining 829 patients (25%) were excluded as their QoL data were incomplete. The issue of incomplete QoL data is a known problem in this kind of research [11]. It is important to notice that the exclusion group is significantly older, has a higher percentage of women and has a higher risk score preoperatively. Table 1 shows that besides age and gender, other risk variables show no significant difference. It

is important to notice that the operative data and the registered hospital and 30-day mortality show no differences between the study population and the exclusion group.

Table 2 shows that hospital and 30-day mortality appear, as expected, in patients who are significantly older and at a higher risk than survivors. The EQ-5D is close to a statistically significant level ($P = 0.048$). The EQ-5D is lower for hospital deaths but shows no significant difference between 30-day deaths and survivors. The EQ-VAS is significantly lower for both hospital and 30-day deaths. Logistic regression analysis shows a significant correlation between hospital mortality and EQ-5D and EQ-VAS, as well as between 30-day mortality and EQ-5D, albeit with a poor association. (Nagelkerke $R^2 < 0.021$ for all correlations).

The c-index for the predictive value of EQ-5D and EQ-VAS for hospital mortality are 0.36 and 0.33, respectively. The c-index for the predictive value of EQ-5D and EQ-VAS for 30-day mortality are 0.39 and 0.35, respectively. These results show that both EQ-5D and EQ-VAS have no prognostic value for hospital or 30-day mortality. The c-index of the additive EuroSCORE for hospital and 30-day mortality (0.80 for both mortality measurements), however, confirms that the additive EuroSCORE is a good prognostic tool to predict the mortality rate of patients undergoing isolated elective CABG surgery.

Our results—no prognostic value of QoL, evaluated by the EuroQoL facility, for hospital and 30-day mortality—seem to be in contrast with previous published researches [4–6]. Rumsfeld *et al.* [4] proved that the preoperative physical component summary (PCS) score is an important independent risk factor for 6-month mortality following CABG surgery [4]. However, emergency and acute operations are included in his study population, and the baseline characteristics of the study population differed greatly from the exclusion group. About 37% of the patients (1476/3956) were excluded in the study, which is much higher than in our research. Another point is that we present a series of 2501 patients operated over a period of 9 and a half years, with a hospital mortality of 25 patients (1%) and a 30-day mortality of 29 patients (1.2%). This is in contrast with Rumsfeld *et al.* [4] who present a series of 2480 patients with a 180-day mortality of 117 patients (4.7%). So, it can be suggested that our number of deaths (endpoints) is too small. However, if elective isolated CABG can be performed with a hospital, 30-day mortality <1.5%, the influence of QoL on this mortality is of course much less. Sündermann *et al.* [5] use the comprehensive assessment of frailty (CAF) to analyse the ability to predict one-year mortality. For their analyses they used a highly specific group of patients, only those with an age of ≥74 years. This is an important difference in our study, mainly because some studies confirm the influence of age on the QoL [12, 13]. QoL is measured using the CAF test, which is a new facility specifically for older patients [5]. Their results show a promising ability to predict one-year mortality, even much better than the EuroSCORE. Székely *et al.* used both PCS and MCS of the SF-12 to predict a prolonged length of in-hospital stay and mortality [6]. The MCS is identified as an independent predictor of a prolonged length of hospital stay and mortality. However, the data set used for their research is almost 10 years old and was gathered together from a total of 72 hospitals in 17 different countries. In addition, they give no additional information about the exclusion criteria used. The problem of missing QoL data and information about the excluded patients is mentioned earlier in the discussion and is not a new phenomenon [14]. In our research, we excluded patients with no or incomplete QoL data. It is interesting to see that the exclusion group is older and at a higher risk for mortality, and this must be taken into account before generalizing the results.

CONCLUSION

In conclusion, our results support the hypothesis that in isolation, poor preoperative QoL, measured using EQ-5D and EQ-VAS, cannot contribute in deciding which patients should undergo isolated elective CABG surgery.

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REFERENCES

[1] Duits AA, Boeke S, Taams MA, Passchier J, Erdman RA. Prediction of quality of life after coronary bypass graft surgery: a review and evaluation of multiple recent studies. Psychosom Med 1997;59:257–68.
[2] Koch CG, Li L, Lauer M, Sabik J, Starr NJ, Blackstone EH. Effect of functional health-related quality of life on long-term survival after cardiac surgery. Circulation 2007;115:692–9.
[3] Mallik S, Krumholz HM, Lin ZQ, Kasi SV, Mattera JA, Roumains SA *et al.* Patients with depressive symptoms have lower health status benefits after coronary bypass surgery. Circulation 2005;111:271–7.
[4] Rumsfeld JS, MaWhinney S, McCarthy M, Shroyer AL, VillaNueva CB, O'Brien M *et al.* Health-related quality of life as a predictor of mortality following coronary artery bypass graft surgery. J Am Med Assoc 1999; 281:1298–303.
[5] Sündermann S, Dademasch A, Rastan A, Praetorius J, Rodruez H, Walther T *et al.* One-year follow-up of patients undergoing elective cardiac surgery assessed with the comprehensive assessment of frailty test and its simplified form. Interact CardioVasc Thorac Surg 2011;13: 119–23.
[6] Székely A, Nussmeier NA, Miao Y, Huang K, Levin J, Feierfeil H *et al.* A multinational study of the influence of health-related quality of life on in-hospital outcome after coronary artery bypass graft surgery. Am Heart J 2011;161:1179–85.
[7] Rumsfeld JS, Magid DJ, O'Brien M, McCarthy M, MaWhinney S, Shroyer ALW *et al.* Changes in health-related quality of life following coronary bypass graft surgery. Ann Thorac Surg 2001;72:2026–32.
[8] Brooks R. EuroQol: the current state of play. Health Policy 1996;37:53–7.
[9] Nashef SAM, Roques F, Michel P, Gauducheau E, Lemeshow S, Salamon R, the EuroSCORE study group. European system for cardiac preoperative risk evaluation (EuroSCORE). Eur J Cardiothorac Surg 1999;16:9–13.
[10] Dolan P. Modeling valuations for EuroQol health states. Med Care 1997; 35:1095–108.
[11] Wouters CW, Noyez L. Is no news good news? Organized follow-up, an absolute necessity for the evaluation of myocardial revascularization. Eur J Cardiothorac Surg 2004;26:667–70.
[12] Markou ALP, Windt van der A, Swieten van HA, Noyez L. Changes in quality of life, physical activity, and symptomatic status one year after myocardial revascularization for stable angina. Eur J Cardiothorac Surg 2008;34:1009–15.
[13] Järvinen O, Saarinen T, Julkunen J, Huhtala H, Tarkka MR. Changes in health-related quality of life and functional capacity following coronary artery bypass graft surgery. Eur J Cardiothorac Surg 2003;24:750–6.
[14] L Noyez L, Jager de MJ, Markou APL. Quality of life post cardiac surgery. Under-researched research. Interact CardioVasc Thorac Surg 2011;13: 511–5.