# Coronary artery bypass graft (CABG) surgery patients in a clinical pathway gained less in health-related quality of life as compared with patients who undergo CABG in a conventional-care plan

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# Coronary artery bypass graft (CABG) surgery patients in a clinical pathway gained less in health-related quality of life as compared with patients who undergo CABG in a conventional-care plan

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**Keywords**
anxiety, CABG, clinical pathway, depression, quality of life

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## Abstract

**Aims and objectives** The aim of this study is to determine the difference between clinical pathway (CP) and conventional care in terms of health-related quality of life (HRQoL) domains, depression and anxiety, as well as to determine the relative contribution of CP towards an improved HRQoL after coronary artery bypass graft (CABG).

**Method** A longitudinal quasi-experimental pre-test/post-test design was used to study and compare clinical outcome, HRQoL depression and anxiety for CP versus conventional-care patients after CABG. HRQoL was measured by using Sf-36, while depression and anxiety were measured by using hospital anxiety and depression scale. Length of stay and patient complications were derived from the hospital database.

**Results** We found that implementing a CP decreased hospital delay from 2.50 ($\pm$7.19) to 1.80 ($\pm$1.60), which was statistically significant $P = 0.002$. We also found that patients in the conventional-care plan improved more than patients in the CP in HRQoL. Outcomes in favour of patients in the conventional-care trajectory were based on the difference between small effect sizes (ES) ($\geq$0.20 <0.50) for pathway patients and moderate ES ($\geq$0.50 <0.80) for conventional-care patients, except for the domain of physical functioning and physical component summary, where the ES for conventional care was large (>0.80).

**Conclusion** The aim of designing and implementing pathways is to decrease length of stay and costs, while maintaining quality of care and improving patient outcomes. Our findings suggest that these aims were not fulfilled in this CABG pathway. We recommend that when designing a CP, all patient-related characteristics, risk indicators, along with physiological status, be taken into consideration.

## Introduction

Nowadays, health-care professionals are faced with the challenge of providing high-quality patient care, while simultaneously cutting costs and decreasing in-hospital length of stay (LOS). This challenge has made the use of clinical pathways (CPs) very appealing, as a tool both for improving outcomes and for decreasing costs during a specific LOS [1,2]. CPs are multidisciplinary management plans that display goals for patients and provide the corresponding ideal sequence and timing for staff action to achieve those goals with optimal efficiency [2,3].

Clinical pathways, when applied to health care, have raised obvious concerns; however, as there are individual patient factors that may contribute to deviations from crucial elements in the pathway plan, CPs have an effect on the outcome expected. Factors such as these cannot be controlled by the pathway

  

guidelines and so need to be considered when modelling the care process. Pathway designers tend to address the ideal patient without co-morbidities or complications, and so they do not control for such confounding patient characteristics before assignment to the pathway [1,4]. Thus, the heterogeneity of the effects of CP, as compared with conventional care, may be because of lack of attention to confounders. Differences in the methodological quality of study designs may further add to this heterogeneity [5,6].

According to our findings in an earlier systematic review [5] on the efficacy of CPs, only 12 out of the 115 studies (10.4%) controlled for selection bias by means of matching. Out of these, three studies matched a random sample from a CP group with controls from a pre-pathway-period group. Furthermore, most of these studies focused on cost issues and reductions in LOS, while clinically relevant outcomes such as discharge disposition, health-related quality of life (HRQoL), depression, anxiety and care dependency were largely ignored. Because there was a tendency to report only the positive or neutral effects of CPs, the negative effects of pathways were rarely reported. However, a systematic review addressing in-hospital care pathways for stroke patients has concluded that patient satisfaction and quality of life can be significantly lower in the care pathway group, while at the same time there was no significant difference in the LOS between the two groups [6,7].

This same trend has emerged in the past decade in relation to evaluating coronary artery bypass graft (CABG) pathways, ever since more comparative cohort studies were conducted to detect the effect of CABG pathways. It has been concluded that CABG pathways did decrease LOS, costs [8–12] and complications [13], but none of these studies provided any evidence regarding quality of life or depression, and anxiety.

This stated, few investigators have used health-related functioning or quality-of-life measures as outcomes in order to detect differences between pathway and conventional-care patients, and have ended up finding that there is no difference between the two groups in relation to HRQoL [14–16].

Generally speaking, it would appear to be difficult to detect statistically significant and clinically relevant differences in trials that evaluate care interventions such as nurse-led disease management, case management and CPs [17,18] in coronary artery diseases, chronic obstructive pulmonary disease and CABG [16]. This is largely because the main effects are induced by (medical) treatments in both control and experimental groups.

In light of these findings, the aim of this study is to determine the difference between CP and conventional care in terms of HRQoL domains, depression and anxiety, as well as to determine the relative contribution of CP towards an improved HRQoL 6 months after CABG.

# Material and method

## Study design

A longitudinal quasi-experimental pre-test/post-test design was used to study and compare clinical outcome, HRQoL, depression and anxiety for CP versus conventional-care patients 6 months after CABG. A conventional randomization procedure was considered inappropriate. Randomizing individual patients (or surgeons) to either a CP or a conventional care within the same hospital invites contamination because many of the same doctors, as well as care staff, are involved in treating the same population of patients. Nevertheless, the assessment of patients' outcomes was done in ignorance of the method of care they were receiving. We therefore used a historical control group and applied the CONSORT criteria [19] for the reporting of randomized controlled trials, finding this the best way to obtain information from this study.

After inclusion, patients received a mailed questionnaire before surgery, accompanied by an informed consent form. Follow-up questionnaires were sent out 6 months after the CABG intervention was executed. The questionnaires, once filled out, were checked for completeness at baseline as well as at follow-up. If a page was not filled in, a copy was sent with a request to please complete the questions or, if it concerned one or fewer questions, patients were interviewed by telephone. Because the completeness of the questionnaire was monitored by a computer programme both at baseline and follow-up, we effectively reduced the non-response on questions and, consequently, on scales.

## Patient selection

Consecutive patients, who were scheduled for CABG following a coronary angiography, were recruited from October 2004 till March 2005, and these constituted the control group receiving conventional care. Patients scheduled for CABG with the application of the CP were recruited from April 2005 till January 2006, from both the University Medical Center Groningen in Groningen and the Haga Hospital in The Hague, both in the Netherlands. Patients with other incapacitating diseases, cognitive impairments, admitted for emergent/urgent CABG, aged 80 and older, or who did not speak Dutch were excluded. Ethical approval was obtained from each participating hospital's ethics committee. An overview of patient selection for the current study is presented in Fig. 1.

A postal follow-up survey was sent out to 256 patients, both at baseline and 6 months after CABG. The response rate at baseline was 77.3% (198/256). When comparing included patients with non-responders, no differences were found between the two groups except with regard to gender ($\chi^2 = 4.85$, d.f. = 1; $P = 0.03$), with 33.3% vs. 21.2% women respectively. Compared with the study baseline sample, dropouts at follow-up did not differ systematically for gender ($\chi^2 = 1.63$, d.f. = 1; $P = 0.20$) and marital status ($\chi^2 = 1.81$, d.f. = 1; $P = 0.18$), nor for mean differences in age ($66.1 \pm 10.09$ vs. $64.59 \pm 9.95$; d.f. = 196; $P = 0.45$). Given that we used a prospective design that included only patients with complete questionnaire data at baseline and 6-month follow-up, our analyses were finally based on 168 patients.

# Procedure

## The clinical pathway

The pathway targeted a maximum LOS of 8 days. Patients followed the pathway designed from admission till discharge; the pathway did not extend after discharge and did not include a follow-up programme. In the preoperative period patients participated in an interactive educational session where they were informed about their preparation for surgery by the cardiothoracic

 

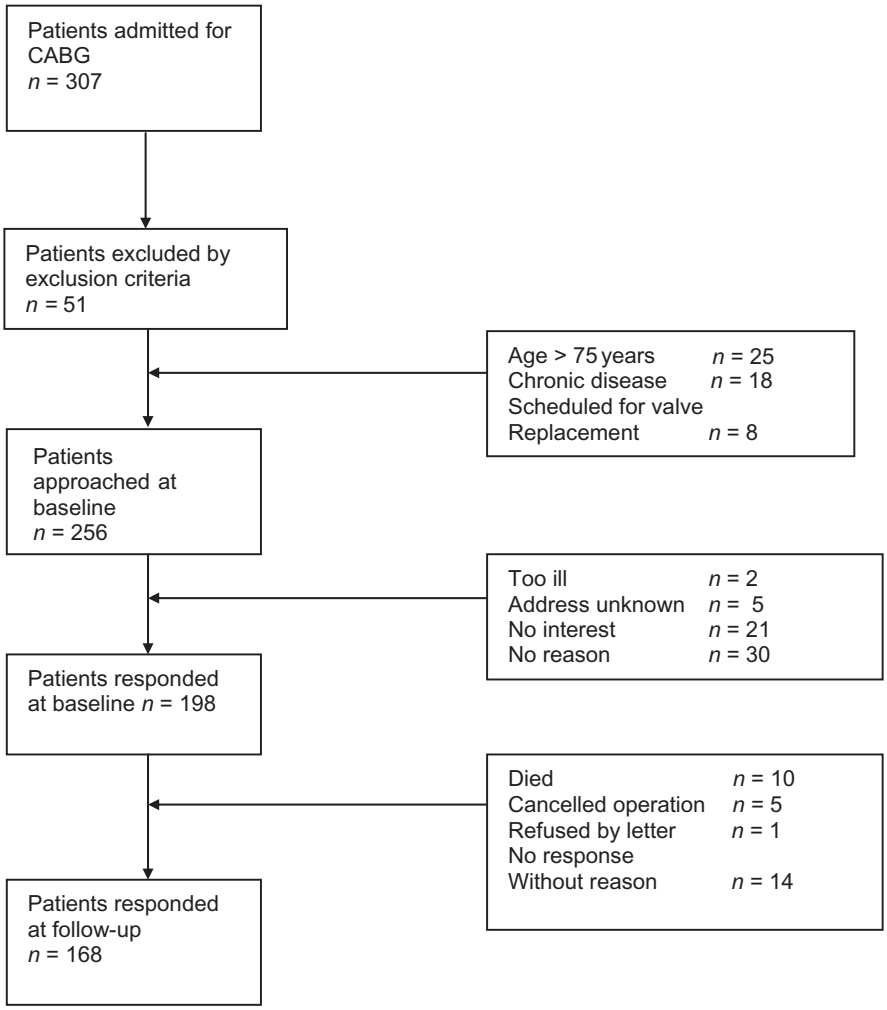


**Figure 1** Overview of patient selection for the current study. CABG, coronary artery bypass graft.

surgeon, the anaesthesiologist and the nurse practitioner. Patients were also informed about what to expect during the preoperative and post-operative periods, and were invited to express their feelings of anxiety and their concerns about surgery and recovery. Furthermore, the nurse practitioner and the physiotherapist prepared patients for discharge by providing education about wound care, the occurrence of complications, physical rehabilitation and exercises, blood sugar and weight control. Patients who underwent CABG in the control group followed the conventional trajectory without structural educational sessions and without controlling for LOS.

## Measures

### Demographic variables

We obtained data on patient characteristics and medical status at baseline. Age and gender were used as reported by patients in the questionnaire. Being married, living with a partner or being a widower were all classified as (1) living with a partner; divorced or living alone were classified as (2) living alone. Educational status was defined as (1) elementary schooling; (2) secondary schooling; (3) higher professional training; and (4) college education/university, based on the highest degree obtained. Work status was defined as (0) working and (1) not working (with housewives classified as working). Smoking was recorded as (0) not smoking and (1) smoking. Type D personality was recorded as (0) type D and (1) non-type D.

### Medical variables and number of perioperative complications

The Risk stratification model EuroSCORE was used to calculate patients' risk levels and patients were later classified into three risk groups: (1) low (additive score of 0–2); (2) medium (scores 3–5); and (3) high risk (scores 3–5) [20–24]. Data on preoperative and post-operative medical and clinical characteristics, such as New York Heart Association, angina, myocardial infarction, left ventricular ejection fraction, chronic pulmonary disease, renal diseases, diabetes, as well as post-operative events such as atrial or ventricular arrhythmia, use of inotropes, re-exploration for bleeding or tamponade, sternal re-suturing, time spent on mechanical ventilation, were all retrieved from the registry database, medical notes, outpatient notes and intensive therapy unit charts.

### Type D personality

We used the Type D Scale (DS14) to assess the distressed (type D) personality [25]. This scale consists of fourteen items that are answered on a five-point Likert scale from 0 (false) to 4 (true). Seven items tap negative affectivity, and seven items tap social inhibition (score range, 0–28 for each subscale). Type D caseness is defined by a high score on both subscales, as determined by a standardized cut-off score ≥10 [25]. The DS14 is a valid and reliable scale with Cronbach's alpha = 0.88/0.86, and 3-month test–retest reliability (r) = 0.72/0.82 for the negative affectivity and social inhibition subscales respectively [25]. Type D personality is more than just negative affect, because it also encompasses how patients deal with this affect through the inclusion of the social inhibition component [25]. The DS14 was administered at baseline.

#### SF-36 (health-related quality of life)

The Short Form Health Survey (SF-36) was sent to patients pre-operatively after they were scheduled for CABG, and post-operatively 6 months after CABG. The SF-36 is a generic measure that assesses eight HRQoL domains, that is, physical functioning, role physical functioning, role emotional functioning, mental health, vitality, social functioning, bodily pain and general health [26]. Scale scores are obtained by summing the items together within a domain, dividing this outcome by the range of scores and then transforming these raw scores to a scale from 0 to 100. A higher score on the SF-36 sub-domains represents better functioning, with a high score on the bodily pain scale indicating freedom from pain. The scale has good reliability with Cronbach's alpha ranging from 0.65 to 0.96 for all subscales [27]. Later, the sub-domains of the SF-36 were dichotomized, with the lowest tertile indicating impaired health status [28–30].

### Hospital anxiety and depression scale (HADS) anxiety and depression

Anxiety and depressive symptoms were assessed at 6 months after CABG by using the seven-item anxiety subscale and the seven-item depression subscale from the HADS [31]. Responses to both subscales are indicated on a four-point Likert Scale from 0 to 3 (score range 0–21). A cut-off score ≥8 was used for both subscales to identify patients with anxiety and depressive symptoms. This cut-off has been shown to balance sensitivity and specificity optimally [32]. The HADS has been shown to be a valid and reliable instrument [32,33] and to predict mortality in patients referred for exercise testing [34].

#### Hospital length of stay, readmission and discharge destination

Length of hospital stay was calculated for each patient in three time intervals: (1) days between date of admission and date of discharge; (2) days between date of admission and date of operation; and (3) days between date of operation and discharge. Destination after discharge was recorded and was defined as (0) home or (1) other (including extended health-care facility, and nursing homes, or hospitals). Readmission after operation because of cardiac-related complaints was assessed 6 months after CABG.

### Analysis

Discrete variables were compared by using the chi-square test (Fisher's exact test, when appropriate, and difference-of-proportions test) [35], and were presented as numbers and percentages. Continuous variables were normally distributed (Shapiro–Wilk, $P > 0.05$), and were therefore compared with the Student *T*-test, and are here presented as means ± SD. All statistical tests were two-tailed. A value of $P < 0.05$ was used for all tests to indicate statistical significance.

First, CP and conventional-care groups were compared at baseline for sociodemographic and clinical characteristics, and the effect sizes (ES) were calculated only for statistically significant results, because differences between groups owing to sample fluctuation had no clinical relevance. Cohen's ES *d* for unrelated samples was used to estimate the magnitude of the statistically significant differences between CP and conventional-care groups (mean difference score/the pooled standard deviation). According to Cohen's thresholds, an ES of <0.20 indicates a trivial difference, an ES of ≥0.20 to <0.50 a small difference, an ES of ≥0.50 to <0.80 a moderate one, and an ES ≥ 0.80 a substantial difference. For differences in proportions between CP and conventional care, Cohen's ES statistic 'w' was used with a threshold of <0.10 for trivial, >0.10 to <0.30 for small, >0.30 to <0.50 for medium, and >0.50 for large differences [36].

Second, we estimated the amount of change between baseline and follow-up for HRQoL, depression and anxiety across the CP and conventional-care groups. The magnitude of change for each scale of the SF-36 and HADS was estimated independently both in the CP group and the control group with a standardized response mean [37], and relative validity methodology [38,39] was used to compare these ES across both groups. Relative efficacy index (RE) coefficients estimate how much groups differ in size of improvement, relative to the most improved group on that health-status measure. In order to estimate the difference in change that may have contributed to the differences in post-operative care methods (in the current study, CP vs. conventional care), we have used the RE.

$$\mathrm{RE} = \frac{\mathrm{ES}_{\mathrm{Pathway}} - \mathrm{ES}_{\mathrm{Controls}}}{\mathrm{ES}_{(\mathrm{most-improved})}} \times 100$$

All statistical analyses were performed using SPSS 13.0.1 for Windows.

## Results

### Patient characteristics

Differences between the pathway and the conventional-care groups, in relation to patient demographics and treatment-related characteristics, were analysed (Table 1). The two groups differed in terms of marital status, level of education, receiving inotropic support and hours on mechanical ventilation. According to Cohen's ES 'w' for difference in proportions, these differences were small [36].

**Table 1** Patients' demographics and pre-operative and post-operative variables in pathway and conventional-care patients

| Patients' characteristics | Pathway group | Conventional care | Total | *P-value* |
|---|---|---|---|---|
| Mean age (years) (±SD) | 64.93 (±9.60) | 64.83 (±10.53) | 64.89 (±9.95) | 0.18 |
| Gender (%) | | | | |
| Male | 91 (75.8%) | 64 (82.1%) | 155 (78.3%) | 0.19 |
| Female | 29 (24.2%) | 14 (17.9%) | 43 (21.7%) | |
| Marital status (%) | | | | |
| Married/living with partner | 101 (84.2%) | 56 (71.8%) | 157 (79.3%) | 0.03 |
| Unmarried, widowed, divorced | 19 (15.8%) | 22 (28.2%) | 41 (20.7%) | |
| Educational level | | | | 95% CI |
| Elementary schooling | 83 (70.3%) | 37 (48.7%) | 120 (61.9%) | –35.6–7.72 |
| Secondary schooling | 19 (16.1%) | 19 (25.0%) | 38 (19.6%) | –2.9–20.7 |
| Higher schooling | 14 (11.9%) | 12 (15.8%) | 26 (13.4%) | –6.1–14.0 |
| College education/university | 2 (1.7%) | 8 (10.5%) | 10 (5.2%) | 1.5–16.1 |
| Work | | | | |
| Not working | 87 (72.5%) | 56 (71.8%) | 143 (72.2%) | 0.52 |
| Working | 33 (27.5%) | 22 (28.2%) | 55 (27.8%) | |
| Type D | | | | |
| Yes | 15 (12.5%) | 8 (10.3%) | 23 (11.6%) | 0.40 |
| No | 105 (87.5%) | 70 (89.7%) | 175 (88.4%) | |
| Smoking | | | | |
| Yes | 6 (6.1%) | 6 (9%) | 12 (7.3%) | 0.35 |
| No | 92 (93.9%) | 61 (91%) | | |
| EuroSCORE | | | | 95% CI |
| Low risk | 36 (32.1%) | 28 (40.6%) | 64 (35.4%) | –6.0–22.9 |
| Medium risk | 46 (41.1%) | 22 (31.9%) | 68 (37.6%) | –23.5–5.1 |
| High risk | 30 (26.8%) | 19 (27.5%) | 49 (27.1%) | –12.6–14.1 |
| I. Pre-operative clinical characteristics | | | | |
| New York Heart Associationfunctional class | | | | 95% CI |
| I | 14 (12.3%) | 7 (9.3%) | 21 (11.1%) | –11.9–6.0 |
| II | 25 (21.9%) | 15 (20%) | 40 (21.2%) | –13.7–9.9 |
| III | 46 (40.4%) | 36 (48%) | 82 (43.4%) | –6.8–22.1 |
| IV | 29 (25.4%) | 17 (22.7%) | 46 (24.3%) | –15.2–9.6 |
| Left ventricular ejection fraction | | | | 95% CI |
| >50 | 82 (75.2%) | 53 (76.8%) | 135 (78.5%) | –11.3–14.4 |
| 30–50 | 24 (22%) | 12 (17.4%) | 36 (20.2%) | –16.5–7.2 |
| <30 | 3 (2.8%) | 4 (5.8%) | 7 (3.9%) | –3.3–9.4 |
| II. Pre-operative medical history: | | | | |
| Chronic pulmonary diseases | 11 (10.1%) | 7 (10.1%) | 18 (10.1%) | 0.59 |
| Previous cardiac surgery | 4 (3.7%) | 1 (1.4%) | 5 (2.8%) | 0.36 |
| Pulmonary hypertension | 4 (3.7%) | 2 (2.9%) | 6 (3.4%) | 0.57 |
| History of angina | 67 (55.8%) | 48 (61.5%) | 115 (58.1%) | 0.26 |
| History of hypertension | 44 (36.7%) | 22 (28.2%) | 66 (33.3%) | 0.14 |
| History of myocardial infarction | 23 (19.2%) | 20 (25.6%) | 43 (21.7%) | 0.18 |
| History of renal insufficiency | 5 (4.2%) | 4 (5.1%) | 9 (4.5%) | 0.50 |
| History of diabetes | 23 (19.2%) | 13 (16.7%) | 36 (18.2%) | 0.40 |
| III. Post-operative events | | | | |
| Mean overall length of stay (±SD) | 10.4 (±5.96) | 10.70 (±8.30) | 10.50 (±6.96) | 0.39 |
| Length of stay | | | | |
| ≤8 days | 48 (42.9%) | 35 (47.3%) | 83 (44.6%) | 0.33 |
| >8 days | 64 (57.1%) | 39 (52.7%) | 103 (55.4%) | |
| Hospital delay* (±SD) | 1.80 (±1.60) | 2.50 (±7.19) | 2.08 (±4.70) | 0.002 |
| Readmission rate | 20 (20.2%) | 7 (10.4%) | 27 (16.3%) | 0.07 |
| Attending a rehabilitation programme | | | | |
| Yes | 40 (40.4%) | 36 (53.7%) | 76 (45.8%) | 0.06 |
| No | 59 (59.6%) | 31 (46.3%) | 90 (54.2%) | |
| Discharge destination | | | | |
| Home | 91 (84.3%) | 61 (88.4%) | 152 (85.9%) | 0.29 |
| Extended care facility | 17 (15.7%) | 8 (11.6%) | 25 (14.1%) | |
| Perioperative events | | | | |
| Atrial arrhythmia | 34 (31.2%) | 24 (34.8%) | 58 (32.6%) | 0.37 |
| Ventricular arrhythmia | 4 (3.7%) | 2 (2.9%) | 6 (3.4%) | 0.57 |
| Use of inotropes | 42 (38.5%) | 15 (21.7%) | 57 (32%) | 0.01 |
| Re-exploration for bleeding or tamponade | 8 (7.3%) | 6 (8.7%) | 14 (7.9%) | 0.48 |
| Time spent on mechanical ventilation (hour) | | | | 95% CI |
| 0–6 | 40 (32.6%) | 18 (26.1%) | 58 (32.6%) | –24.4–23.1 |
| 6–12 | 34 (31.2%) | 19 (27.5%) | 53 (29.8%) | –17.3–10.0 |
| 12–24 | 14 (12.8%) | 18 (26.1%) | 32 (18.0%) | 1.1–25.4 |
| >24 | 21 (19.3%) | 14 (20.3%) | 35 (19.7%) | –1.0–13.1 |

CI, confidence interval.
*Time between admission and operation in days.

### Length of stay, discharge destination and readmission

As regards LOS and waiting time till surgery, we found that implementing a CP decreased hospital delay (number of days the patient spent in the hospital from admission to operation) from 2.50 (±7.19) to1.80 (±1.60), which was statistically significant $P = 0.002$. However, according to the thresholds of Cohen's ES *d*, this difference has to be considered trivial (ES = 0.15) [36]. Moreover, there was no statistically significant difference between both groups in relation to the number of patients exceeding 8 days of stay in the hospital. The number of patients in the pathway group who exceeded the 8-day LOS (fell off the pathway) was 64 (57.1%), while in the conventional-care group 39 (52.7%) of the patients exceeded 8 days.

Furthermore, there was no statistically significant difference between the two groups in relation to discharge destination (i.e. discharge to home or to extended care facility), attending a rehabilitation programme after surgery or readmission rate, in addition, all readmissions were to the hospital where patients had surgery.

### Differences in improved HRQoL across clinical pathway and conventional-care patients 6 months after CABG

Treatment-related improvements in both CP and conventional-care groups were statistically significant, and these effects indicate clinically relevant change [40] in HRQoL and anxiety. However, patients in the CP improved relatively less than did patients in conventional care in terms of HRQoL for the six domains of physical and mental HRQoL: (1) physical functioning; (2) social functioning; (3) physical role functioning; (4) mental functioning; (5) vitality; and (6) bodily pain (Table 2). Regarding both physical and mental component scores, conventional-care patients gained relatively more than pathway patients did.

In contrast to these comparisons, patients in the CP improved substantially more in terms of emotional role functioning, which yielded the highest RE, and in general health.

No differences were found in the magnitude of decreased depression, but the level of anxiety decreased more in conventional-care patients than in CP patients. It was also found that, in relation to pain, both groups improved equally with moderate ES.

Outcomes in favour of patients in the conventional-care trajectory were based on the difference between small ES (≥0.20 <0.50) for pathway patients and moderate ES (≥0.50 <0.80) for conventional-care patients, except for the domain of physical functioning and physical component summary, where the ES for conventional care was large (>0.80).

## Discussion

To our knowledge this is the first controlled study to investigate the effect of being in a pathway for CABG patient outcomes. We controlled for variations by matching patients based on age, gender and EuroSCORE. Although the main goal of implementing CPs is to decrease LOS, being in a pathway did not decrease LOS in the current study. Moreover, there was no statistically significant difference between the conventional-care group and the pathway

**Table 2** Relative efficacy across SF-36 domains of health-related physical and mental quality of life and hospital anxiety and depression

| Items | Physical functioning | Social role | Role physical | Role emotional | Mental health | Vitality | Bodily pain | General health | PCS | MCS | Anxiety | Depression |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Pathway group | | | | | | | | | | | | |
| Mean difference between baseline and follow-up (*P*-value) | 16.01*** | 9.72*** | 19.19*** | 17.51*** | 6.10** | 9.75*** | 12.989*** | 11.78*** | 14.99*** | 10.77*** | 3.18*** | 2.30*** |
| Effect size† | 0.64 | 0.38 | 0.46 | 0.44 | 0.31 | 0.44 | 0.58 | 0.59 | 0.61 | 0.38 | 0.28 | 0.68 |
| Conventional-care group | | | | | | | | | | | | |
| Mean difference between baseline and follow-up (*P*-value) | 19.51*** | 13.06*** | 26.24*** | 7.46* | 10.13*** | 10.82*** | 15.33*** | 7.89** | 17.24*** | 10.37*** | 2.42*** | 1.00* |
| Effect size† | 0.89 | 0.60 | 0.65 | 0.18 | 0.58 | 0.53 | 0.62 | 0.42 | 0.82 | 0.51 | 0.56 | 0.70 |
| ES conventional care–ES pathway | 0.25 | 0.22 | 0.21 | –0.26 | 0.27 | 0.09 | 0.04 | –0.17 | 0.21 | 0.13 | 0.28 | 0.02 |
| Relative efficacy index | 28.09 | 36.67 | 29.23 | –59.09 | 46.55 | 16.98 | 6.45 | –28.81 | 25.6 | 25.49 | 50 | 4.22 |

PCS, physical components summary; MCS, mental components summary; ES, effect size.
†ES were calculated only for the statistically significant results, because differences between groups that are resulting from sample fluctuation have no clinical relevance.
*$P \leq 0.05$; **$P < 0.01$; ***$P < 0.001$.

group regarding readmission rates. Patients in the pathway group, however, had a decreased admission-operation delay (days in hospital between admission and operation). Improvement in HRQoL after CABG was realized in both groups (also for patients who had, according to our cut-off criterion, poor health status). We found, however, that patients receiving conventional care improved relatively more, as compared with pathway patients, for the six sub-domains of SF-36, but not for the domains of emotional role functioning and general health. In addition, the conventional-care group improved more on both the physical and mental component summary. Regarding depression and anxiety, there was no difference between groups in relation to depression levels, but patients in the conventional-care group decreased in anxiety relatively more when compared with the pathway-group patients. Other studies that investigated the effect of the CABG pathway on health-related functional status found no differences between the two groups [15,16].

Our findings confirm that confounding individual characteristics and differences must be taken into consideration in designing the pathways. Factors such as ethnicity, co-morbidity, personality traits, risk indicators and occurrence of perioperative incidences affect patients' perceived health status. Do CPs account for these differences? Few authors posed the same questions and investigated whether pathways should be based on the acuity of patient conditions [41], or the presence of pre-operative risk factors and perioperative incidences [42]. Yet they come to the same conclusion, and that was when designing a pathway, all these factors need to be taken into consideration. Moreover, a systematic review by Dy and colleagues [43], focused on determining the effectiveness of CPs, concluded that 'clinical pathways tended to be effective when applied to procedures with lower complexity/severity of illness.' They also stated that 'because pathways tend to be relatively inflexible and oriented toward patients with predictable course of care, they may not work well when care is more variable as in intensive care unit.'

### Strengths and limitations

The strength of this study lies in the fact that we compared outcomes of a CP with a control group under conventional care, and controlled for potential confounders, namely, age, gender and EuroSCORE through matching. The limitations of the study lie in the fact that: (1) randomizing individual patients (or surgeons) to a CP or conventional care in the same hospital was inappropriate as this would induce contamination bias; (2) at the start of the current study there was no controlled study that evaluated the effects of CP on health-related functional status, which therefore made it impossible to perform a power analysis; and that (3) although reminders were sent at baseline for non-responders and at follow-up for dropouts, 23% of patients declined to participate at baseline and 12% dropped out at follow-up.

## Conclusion

In conclusion, the aim of designing and implementing pathways is to decrease LOS and subsequently decrease costs, while at the same time maintaining quality of care and improving patient outcomes. Our findings suggest that these aims were not fulfilled in the CABG pathway. It has been argued that CPs address the 'ideal patient' [1], which we tend to agree with, and thus in light of these findings, we recommend that when designing a CP, all patient-related characteristics, risk indicators, along with physiological status, be taken into consideration. Moreover, pathways should be designed and LOS set based on patients' acuity of illness and a follow-up period should be added for these patients in order to ensure optimum outcome. In addition, we also recommend incorporating HRQoL measurement as part of a routine assessment of patient health, both pre- and post-operative, because this will provide a clear view of the patient's perception of his physical functioning and mental health, which will, in turn, have a great impact on planning care and counselling patients. Further research is needed to evaluate the effects of CP when designed in such a way.

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