

Effect of a Preoperative Intervention on Preoperative and Postoperative Outcomes in Low-Risk Patients Awaiting Elective Coronary Artery Bypass Graft Surgery

A Randomized, Controlled Trial

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Background: In publicly funded health care systems, a waiting period for such services as coronary artery bypass graft surgery (CABG) is common. The possibility of using the waiting period to improve patient outcomes should be investigated.

Objective: To examine the effect of a multidimensional preoperative intervention on presurgery and postsurgery outcomes in low-risk patients awaiting elective CABG.

Design: Randomized, controlled trial.

Setting: A regional cardiovascular surgery center in a tertiary care hospital, southwestern Ontario, Canada.

Patients: 249 patients on a waiting list for elective CABG whose surgeries were scheduled for a minimum of 10 weeks from the time of study recruitment.

Intervention: During the waiting period, the treatment group received exercise training twice per week, education and reinforcement, and monthly nurse-initiated telephone calls. After surgery, participation in a cardiac rehabilitation program was offered to all patients.

Measurements: Postoperative length of stay was the primary outcome. Secondary outcomes were exercise performance, general health-related quality of life, social support, anxiety, and utilization of health care services.

Results: Length of stay differed significantly between groups. Patients who received the preoperative intervention spent 1 less day [95% CI, 0.0 to 1.0 day] in the hospital overall ($P = 0.002$) and less time in the intensive care unit (median, 2.1 hours [CI, -1.2 to 16 hours]; $P = 0.001$). During the waiting period, patients in the intervention group had a better quality of life than controls. Improved quality of life continued up to 6 months after surgery. Mortality rates did not differ.

Conclusion: The waiting period for elective procedures, such as CABG, may be used to enhance in-hospital and early-phase recovery, improving patients' functional abilities and quality of life while reducing their hospital stay.

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In Ontario, Canada, the discrepancy between the high demand for coronary artery bypass graft surgery (CABG) and the low immediate supply results in waiting lists. In 1990, a consensus panel of cardiologists and surgeons developed criteria to ensure that high-risk patients were given priority for this procedure (1). Each patient receives an acuity score that corresponds to a recommended maximum delay. Aggregated acuity scores of 4, 5, 6, and 7 indicate elective status and represent a waiting time ranging from greater than 14 days to a maximum of 6 months.

The mortality rate for patients awaiting CABG has been shown to be remarkably stable—approximately 0.5% to 0.6% per year over the past 10 years (2). Despite this, however, evidence shows that patients' functional and psychological status can deteriorate during the wait for surgery (3–5). Through its effects on the autonomic nervous system, emotional stress also influences catecholamines, myocardial oxygen demand, and platelet aggregation; this may

affect morbidity during the waiting period (6–8). Such factors as preoperative anxiety and little social support have adverse psychological effects during extended preoperative waiting periods and, in addition, have been found to predict poor physical recovery from heart surgery (9). Therefore, psychological factors and physical deconditioning, both of which occur during the waiting period (10–12), may negatively affect patients' in-hospital course, including length of stay. Because waiting for health services will probably continue to be a reality in publicly funded health care systems that value universal access, careful study of simple, affordable methods to improve patient outcomes during the waiting period is warranted.

We examined the effect of a minimum 8-week, multidimensional, preoperative intervention on the presurgery and postsurgery outcomes of patients awaiting elective CABG. We hypothesized that a combination of exercise training, education, and social support would affect pa-

tients' physical and psychological readiness for surgery and thereby reduce postoperative length of hospital stay. We further hypothesized that the effectiveness of the preoperative intervention would be sustained into the first 6 months of the postoperative period.

Methods

Patients

Patients were recruited from the waiting lists of all seven cardiovascular surgeons operating in the Hamilton Health Sciences Corporation surgical center, Hamilton, Ontario, Canada. Each year, approximately 1300 open-heart surgeries are performed in this center. Roughly 60% of patients awaiting CABG have elective status and are placed on the waiting list. During the time of our study, elective waiting times ranged from 3 weeks to greater than 20 weeks. Approximately 40% of elective patients are usually awaiting first-time CABG (non-valve replacement). Only patients awaiting a first CABG whose surgery dates were at least 10 weeks away were approached to participate in our study. Patients were excluded if they were having combined CABG and valve surgery, if their ejection fractions were less than 0.40, if they could not attend the exercise classes because of geographic inaccessibility, or if they were unable to participate because of physical limitations. After these inclusion and exclusion criteria were applied, our pool of potential participants was approximately 250 patients per year. We intended to select low-risk patients because it is not common to test an exercise intervention in patients awaiting CABG.

Design

We designed a two-group randomized, controlled trial. Eligible patients were randomly assigned to 8 weeks of multidimensional preoperative intervention or to usual care. Those assigned to usual care were followed by their primary care physicians, cardiologists, or surgeons. During the waiting period, the intervention group received individualized, prescribed exercise training twice per week in a supervised environment; education and reinforcement; and monthly nurse-initiated telephone calls to answer questions and provide reassurance. After surgery, patients in both the treatment and control groups were given the opportunity to join the existing cardiac rehabilitation program (Appendix).

Outcomes

The primary outcome was postoperative length of hospital stay. Secondary outcomes were peak exercise perfor-

mance, health-related quality of life, social support, anxiety, and utilization of health care services. Measurements were taken at baseline, 1 week before surgery, 6 to 8 weeks after surgery, and 6 months after surgery. All of the secondary outcome variables were measured at baseline and 1 week before surgery. At 6 weeks and 6 months after surgery, only exercise performance, quality of life, and social support were measured.

Determination of Sample Size

Sample size was determined by using 1994–1995 data on length of stay in our surgical center. According to a random sample of 20 patients undergoing elective CABG, the mean total length of stay \pm SD was 9.4 ± 3.5 days. On the basis of these data, and accounting for a loss of 10% to 15% of patients, we determined that a sample size of 125 patients per group had sufficient power (0.8) to detect a 1-day reduction in hospital stay ($\alpha = 0.05$).

Procedures

The Research Ethics Board of McMaster University (Hamilton, Ontario) and the study hospital approved the study. On a weekly basis, staff at each of the surgeon's offices supplied the names of patients who were scheduled to wait at least 10 weeks for surgery. Patients were telephoned, and the study was explained to them. The recruitment officer was completely candid about the random assignment and the treatments that would be offered to each group. Within 1 week after giving verbal consent, patients came to the clinic to provide written informed consent. At this visit, we collected complete baseline data and patients underwent an exercise test. Baseline data included demographic information (age, sex, socioeconomic status, living arrangements, education, and employment status); medical history; past and present smoking status; and history of myocardial infarction, angina, congestive heart failure, and diabetes. Baseline data were also collected on anxiety, health-related quality of life, utilization of health care services, and social support. Data later obtained from medical records included total length of hospital stay, length of postoperative stay, number of hours spent in the intensive care unit (ICU) before receiving a discharge order, and actual hours spent in the ICU.

Randomization and Blinding

The study coordinator randomly assigned patients to study groups by using a concealed randomization process.

A consultant prepared the randomization schedule, and assignments were sealed in opaque envelopes that were opened in sequence after consent and baseline data were obtained. Patients were not blinded to their group assignments. However, the patients' physicians (cardiologists, surgeons, and general practitioners) were blinded to group assignment and were not informed of it at any point in the study by patients or health care staff. Persons involved in offering the intervention (nurses, kinesiologists, dietitians) were aware of the patients' group assignments but had no role in determining the patients' readiness for discharge from the ICU or from the hospital; therefore, they did not directly affect the primary outcome.

Assessment of Outcomes

Data on length of stay were collected by individual chart review. Total length of stay and total length of ICU stay were easily determined by using admission and discharge dates. However, after discussion with the cardiovascular surgeons before the study began, we realized that total length of ICU stay would misrepresent patients' postoperative progress. On many occasions, the patient is ready for discharge from the ICU but bed or staffing issues substantially delay his or her actual departure. Therefore, we collected data on length of ICU stay in hours and, more particularly, in "hours until order for ICU discharge." This required detailed chart review to locate "time in" and "time out" information as well as the time that the physician's discharge order was given. Although the physicians often did not record the times of their orders, these data were found in nurses' ICU notes. In approximately 5% of cases, the data were not retrievable and the mean "time until order for discharge" was imputed.

Exercise performance was measured by using a symptom-limited, upright-cycle ergometer exercise test. General health-related quality of life was measured by using the Medical Outcomes Study 36-item Short Form Survey (SF-36) (13). Social support was measured by using the Interpersonal Support Evaluation List (14), and the total scale score was used in analysis. Anxiety was measured with the Spielberger State-Trait Anxiety Inventory (15), from which both a trait score and a state anxiety score were computed. The total score from the Health Services Utilization Questionnaire (16) was computed and used in the analysis (Appendix).

Statistical Analysis

All analyses were performed by using the SPSS statistical package (17), versions 6.0 and 8.0 (SPSS, Inc., Chicago, Illinois). We analyzed data on patients whose status was elective from study entry until 1 week before surgery ($n = 220$). Data were complete for the primary outcome variables. When a measurement tool did not supply an approach for dealing with missing data, we used an imputation strategy, the "hot deck" approach (18), in which the score from a matched patient in the same group is substituted for the missing score. The defining characteristics for matching patients were age, sex, and number of bypasses required. At the measurement point 6 months after surgery, 78% of patients returned for all final assessments. Follow-up to establish vital status was complete for all patients.

Data on length of stay are usually positively skewed. Therefore, we selected the Mann-Whitney test for non-normally distributed continuous variables. Medians were used because of their robustness in the presence of outliers. Confidence intervals for the medians were obtained from the empirical percentiles of 5000 bootstrap samples. Separate analyses—*t*-tests on change scores—were conducted to examine change between groups during the actual waiting period. Analyses across all time points were conducted by using repeated-measures analysis of variance. In all tests, we controlled for the baseline difference in peak oxygen consumption ($\dot{V}O_2$). Statistical tests were two-sided, and a *P* value less than or equal to 0.05 was considered statistically significant.

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The funding agency had no role in the collection, analysis, or interpretation of the data or in the decision to submit the manuscript for publication.

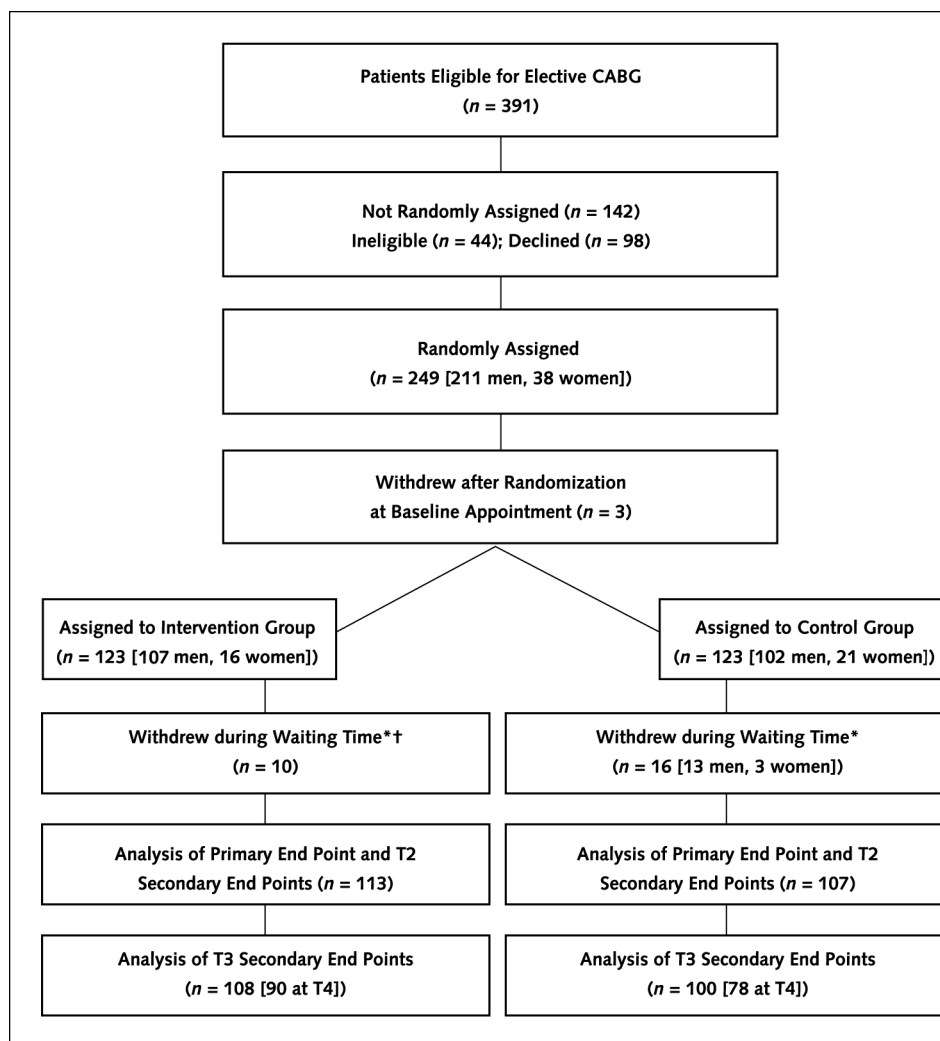
Results

Patients

Patients were recruited from 15 July 1995 to 15 October 1997. During that period, the cardiovascular surgeons referred 391 patients awaiting elective, first-time CABG. Of those 391 patients, 44 were ineligible, 88 declined to participate, and 10 who consented withdrew before randomization.

A total of 249 patients were randomly assigned to study groups. Twenty-nine patients withdrew after ran-

Figure 1. Flow of patients through the trial.



* Change in elective status. † Men only. CABG = coronary artery bypass graft surgery; T2 = 1 week before surgery; T3 = 6 to 8 weeks after surgery; T4 = 6 months after surgery.

domization. Three patients (2 men, 1 woman) requested to withdraw at baseline, 10 men had their surgeries canceled, 12 patients (10 men, 2 women) had a change in status from elective to urgent, and 4 patients (3 men, 1 woman) withdrew at the preoperative measurement point. **Figure 1** summarizes the flow of patients through the trial.

Adherence to Intervention Protocol

The mean number of weeks on the waiting list was 10.8 for the entire sample, 11.4 weeks for the treatment group, and 10.3 weeks for the control group. Patients in the treatment group attended a mean of 14 exercise classes (range,

1 to 57 classes) over a mean exposure time of 8.3 weeks. The wide range reflects the nonadherence of some participants (at the low end of the range) and the lengthy waiting period of some participants (at the high end of the range). All patients received the educational interventions (one-on-one and on videotape) at baseline and 1 week before surgery. All patients received at least one home telephone call from a nurse clinician during the waiting period.

Baseline Characteristics

At baseline, the study groups did not differ for most variables (Table 1). Both groups had similar medical back-

grounds, and both had the same average number of aortocoronary bypasses. Resting heart rate, blood pressure, and use of β -blockers were not significantly different at baseline. There were slightly more women in the control group, although this difference was not statistically significant. A statistically significant difference in $\dot{V}O_2$ was seen between groups at baseline; however, the absolute difference was just less than 10% (126 mL/min) and is therefore of questionable clinical significance. It may be partially explained by the higher number of women in the control group. The study did not include enough women to allow us to conduct separate analyses by sex.

Primary Outcome

All length-of-stay measures differed significantly between groups (Table 2). Differences were confirmed in *t*-test comparisons for groups with unequal variances. The median total length of hospital stay was 6 days for patients who received the preoperative intervention and 7 days for patients who received usual care. Similarly, the median length of postoperative stay was 5 days for the treatment group and 6 days for the control group. Patients who received the preoperative intervention spent significantly less time in the ICU. The two groups did not differ in certain markers of postoperative complications, such as episodes of atrial fibrillation (chi-square test, 1.02; $P > 0.2$).

Secondary Outcomes during the Waiting Period

Patients in the treatment group showed statistically significant improvement on the Physical Composite Summary Score of the SF-36 during the waiting period. Most of this change was the result of improvements in the physical aspects of role functioning. In addition, although physical functioning scores decreased in all patients, those in the control group worsened significantly more than those in the intervention group (Table 3). From baseline to 1 week before surgery, the two groups did not differ in the Mental Composite Summary Score of the SF-36. The Mental Composite Summary Score improved in both groups during the waiting period, although the changes were not significant (Table 3).

Change in state anxiety scores did not differ between groups 1 week before surgery. Of note, both groups had relatively unchanged state anxiety scores throughout the entire waiting period. At baseline and 1 week before surgery, mean state anxiety scores were approximately 37 for

Table 1. Baseline Characteristics

Variable	Intervention Group (n = 123)	Control Group (n = 123)
Sociodemographic characteristics		
Men, %	87.8	82.9
Women, %	12.2	17.1
Mean age \pm SD, y	61.8 \pm 8.4	63.8 \pm 7.8
Living alone, %	12.2	14.5
Mean education, y	12.2	11.1
Employed (full-time, part-time, self), %	20.3	15.3
Not employed (compensation, disability, retired), %	79.7	84.7
Medical history		
Previous myocardial infarction, %	52.6	52.1
Diabetes, %	16.4	25.6
Current smoker, %	20.3	13.0
Current use of β -blockers, %	73.6	73.4
Aortocoronary bypasses (mean/median), n/n	2.6/3.0	2.6/3.0
Baseline measurements		
Peak oxygen consumption \pm SD, mL/min	1327.6 \pm 320	1201.2 \pm 288*
Resting heart rate \pm SD, beats/min	66 \pm 12.3	69 \pm 13.7
Blood pressure, mm Hg	132/79	136/80
Psychosocial measures†		
Anxiety (State-Trait Anxiety Inventory)		
State	37.2	39.0
Trait	37.0	39.5
Medical Outcomes Study		
Quality of life (36-item Short Form Survey)		
Physical Composite Summary Score	34.7	34.2
Mental Composite Summary Score	49.1	46.5
Utilization of health care services, \$	2302.71	2702.77
Social support (Interpersonal Support Evaluation List)	33.1	33.6

* $P = 0.009$

† Mean values.

the treatment group and approximately 39 and 38, respectively, for the control group. During the waiting period, the groups did not differ in change in exercise test performance, utilization of health care services, or perceived social support.

Secondary Outcomes during the Entire Study Period

The group \times time interaction during the waiting period with respect to the Physical Composite Summary Score shows that the intervention had a positive effect on the physical aspect of health-related quality of life (Figure 2). Although both groups improved steadily after surgery,

Table 2. Length-of-Stay Outcomes

Length of Stay	Intervention Group Median (Interquartile Range)	Control Group Median (Interquartile Range)	Estimated Difference in Medians (95% CI)	P Value
Time until order for discharge from intensive care unit, <i>h</i>	19.67 (15.91–23.25)	21.16 (18.49–39.57)	1.5 (0.2 to 4.5)	0.001
Actual time in intensive care unit, <i>h</i>	24.67 (21.68–41.85)	26.71 (22.76–46.50)	2.0 (–1.2 to 16.0)	0.038
Time spent in the hospital after surgery, <i>d</i>	5 (5–6)	6 (5–7)	1.0 (0.98 to 1.0)	0.001
Total time in hospital, <i>d</i>	6 (5–7)	7 (6–8)	1.0 (0.0 to 1.0)	0.002

the preoperative improvement in the intervention group was sustained throughout the first 6 postoperative months. The main effect for time on the Mental Composite Summary Score indicates that mental health improved in both groups from surgery to 6 months after surgery (Figure 2). Although perceived social support during the waiting period did not differ between groups, the treatment group reported more support 6 months after surgery ($t = 3.18$; $P = 0.002$). More patients in the intervention group (70%) than in the control group (57%) elected to participate in postoperative cardiac rehabilitation.

Event Rate

No patients died while waiting for surgery (0% [95% CI, 0% to 1.66%]). Cardiac status worsened in 12 patients during the waiting period (4 in the intervention group and 8 in the control group). Of these 12 patients, 2 women in the control group, 3 men in the control group, and 1 man in the intervention group developed unstable angina. Two men in the control group and 1 in the intervention group had myocardial infarction, and 1 man in the control group and 2 in the intervention group had surgery sooner than originally scheduled because of worsening status that was not given a diagnosis. One man (0.45% [CI, 0.01% to 2.51%]) died of noncardiac causes between the 6- to 8-week postoperative follow-up and the 6-month postoperative follow-up.

Discussion

This is one of the first randomized, controlled trials of a multidimensional intervention over the entire waiting period before elective CABG. As we hypothesized, the composite effect of the intervention was related to a significant reduction in the length of total, postoperative, and ICU hospital stay. This finding is important because it suggests that the waiting period for elective procedures, such as CABG, may be used to enhance in-hospital and

early-phase recovery and thereby reduce length of stay. Our study was unique because we implemented exercise training before CABG in the belief that it would reduce physical deterioration during the waiting period and contribute to sustained postoperative exercise. We found that most patients who began exercise training before surgery (70%) elected to continue in rehabilitation after surgery, compared with only 57% of controls who had not been exposed to preoperative training. This, combined with the finding that patients in the treatment group reported higher physical health–related quality-of-life scores, suggests that the positive functional status of the treatment group before surgery encouraged them to continue with rehabilitation after surgery.

We also found that our preoperative intervention was safe. This is important because it was necessary to demonstrate that preoperative involvement in rehabilitation programs, especially exercise programs, is not harmful to patients awaiting CABG. We observed no deaths over an average waiting time of approximately 3 months, which is consistent with the low mortality rates reported annually in Ontario (2). Morbidity, defined as an aggregate of myocardial infarction and unstable angina, was 3.8% in the total sample. This is consistent with the work of Carrier and colleagues (19), who reported the frequency of myocardial infarction to be 0.5% and the rate of unstable angina to be 3.4% over an average waiting period of 4.6 months. Our findings suggest that there is little risk involved in enrolling patients awaiting CABG in individualized exercise training as part of a comprehensive program.

Most of the literature discusses interventions that have been used successfully after surgery. Some authors have studied individual preoperative interventions of short duration. For example, preoperative education (20), typically provided the day of or before surgery, has been positively related to postoperative outcomes, such as reduced self-reported pain and increased well-being. We provided edu-

cation and support to the treatment group during the entire waiting period. Although we expected these interventions to result in lower anxiety and higher perceived social support before surgery, our findings did not support this. Population norms for state anxiety scores suggest that scores of approximately 33 indicate a relaxed state, scores of approximately 37 are normal, and scores between 43 and 50 indicate stressful conditions (15). Of interest, patients in both groups reported normal levels of anxiety throughout the waiting period, including 1 week before surgery. In addition, all patients reported moderately high levels of social support, possibly because CABG was such a major life event in this cohort that potential sources of support were mobilized. The two groups differed significantly in social support scores 6 months after surgery; therefore, patients who began exercise classes before surgery and continued them afterward may have considered them another source of support. In addition, if patients maintained formal efforts at lifestyle change after surgery, family members may have been reminded that they still had a health concern. This, in turn, may have contributed to sustained family support.

The cost of this intervention is more than offset by the cost savings realized by the reduced length of stay. In Ontario and throughout Canada, the rate for 1 day in the hospital is \$715. On the basis of hospital data regarding the cost of the multidisciplinary cardiac rehabilitation clinic, we calculated that the preoperative intervention would cost \$342 per day. The cost of an exercise test before the intervention is \$240. Therefore, if length of stay is reduced by 1 day, there is a net cost savings of approximately \$133 per patient per day.

The generalizability of our findings may be restricted because of several limitations. First, this was a single-center trial in which the participants were relatively healthy. However, as mentioned, it was important to initially establish the safety and effectiveness of this intervention in a low-risk group. Our findings suggest that the intervention may be extended to most patients awaiting elective CABG. Second, because the sample was small, we could not determine the relative contributions of each intervention component to the ultimate outcome. Third, some of the findings may be confounded by the Hawthorne effect. Finally, if this intervention were offered during short waiting periods, we probably would not have seen the same outcomes because of insufficient time to generate an effect.

In summary, our research contributes to knowledge in two critical areas. Naylor (21) stated that waiting lists provide opportunities to 1) improve efficiency in the use of currently available resources and 2) examine and perhaps improve the experience of persons waiting for services. We used an intervention that included physical and psychological components to improve the health-related quality of life of patients waiting for elective CABG. In addition, preoperative use of available resources proved to be an efficient way of reducing overall postoperative length of stay. Future research might be directed toward using health service waiting lists to improve patient outcomes.

Appendix: Description of Intervention and Measurements

Intervention

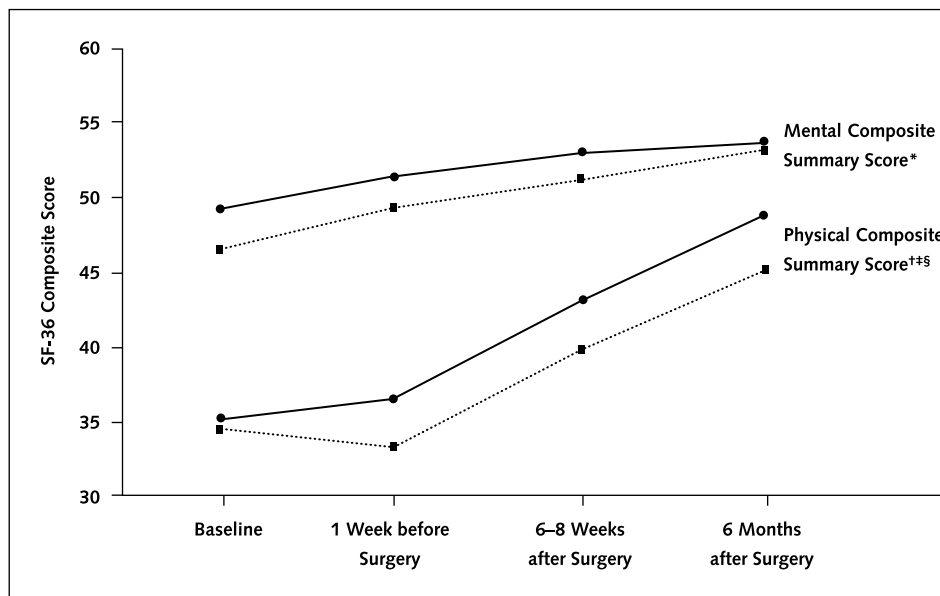
Exercise training consisted of group sessions twice per week, which were supervised by kinesiologists and exercise specialists in

Table 3. Change in Health-Related Quality of Life during the Waiting Period*

SF-36 Subscale	Mean Change from Baseline ± SD		Mean Difference (95% CI)	P Value
	Intervention Group (n = 111)	Control Group (n = 109)		
Physical role	9.46 ± 34.39	-2.06 ± 33.70	11.52 (2.47 to 20.57)	0.01
Physical functioning	-1.17 ± 18.46	-6.56 ± 20.12	5.39 (0.26 to 10.52)	0.04
General health	8.22 ± 18.20	4.14 ± 18.78	4.08 (-0.84 to 8.99)	0.10
Bodily pain	3.58 ± 22.24	4.11 ± 20.54	-0.53 (-6.23 to 5.16)	>0.2
Physical Composite Summary Score	1.55 ± 7.48	-1.46 ± 7.81	3.00 (0.97 to 5.04)	0.04
Vitality	-0.95 ± 18.46	-1.19 ± 15.48	0.25 (-4.28 to 4.78)	>0.2
Social functioning	4.50 ± 24.70	0.92 ± 24.10	3.59 (-2.90 to 10.07)	>0.2
Emotional role	7.51 ± 45.32	16.82 ± 44.82	-9.31 (-21.29 to 2.67)	0.13
Mental health	2.05 ± 18.52	0.77 ± 17.11	1.28 (-3.46 to 6.02)	>0.2
Mental Composite Summary Score	1.54 ± 10.55	2.93 ± 9.15	-1.39 (-4.02 to 1.24)	>0.2

* SF-36 = Medical Outcomes Study 36-item Short Form Survey.

Figure 2. Change in health-related quality of life over time.



Solid lines indicate the treatment group; dotted lines indicate the control group. * Significant main effect for time (baseline to 6 months after surgery): $F = 8.49$; $P < 0.001$. † Significant group-by-time interaction (baseline to 1 week before surgery): $F = 8.47$; $P = 0.004$. ‡ Significant main effect for group (baseline to 6 months after surgery): $F = 8.63$; $P = 0.0038$. § Significant main effect for time (1 week before surgery to 6 months after surgery): $F = 120.6$; $P < 0.001$. SF-36 = Medical Outcomes Study 36-item Short Form Survey.

a hospital environment. Each patient was given an individual exercise prescription on the basis of his or her exercise test results; exercise intensity was 40% to 70% of functional capacity. Each session was 90 minutes long and included the following components: walking warm-up of 5 to 10 minutes with general range-of-motion exercises; 10 minutes of stretching; a minimum of 30 minutes of aerobic interval training on stationary cycles, treadmills, arm ergometers, and stair climbers; and 5 to 10 minutes of cooldown and stretching. The supportive-educative component of the intervention consisted of detailed preoperative teaching at study entry and 1 week before surgery as well as monthly telephone contact by nurse clinicians. The educational content at study entry was broad, providing standardized information about cardiac risk factors in both videotaped and written formats. Patients were given the opportunity to ask questions. Nurse clinicians discussed psychological issues related to waiting for surgery with both patients and families at study entry and during telephone calls. Patients were referred to the clinic psychologist if necessary.

One week before surgery, information about the surgery and sequencing of hospitalization events was presented. Details about what to expect in early postsurgery recovery and the roles of various health care providers involved in postoperative care were provided. Spouses and family members were informed of what to expect when they saw the patient after surgery. Patients and family members viewed a second, more specific videotape that

showed former clinic patients discussing their experiences with CABG and that therefore had personal relevance. As part of usual care, controls saw the videotape at their intake appointment 1 week before surgery.

All patients in the intervention group were encouraged to stop smoking at study entry and again 1 week before surgery. Because waiting for CABG is stressful and readiness and motivation for change may be low, smoking cessation was encouraged but not overemphasized during the waiting period. Instead, patients in the intervention group were simply reminded of the potential immediate postoperative benefits of smoking cessation before surgery. Smoking cessation programs were, however, a formal part of the postoperative rehabilitation program.

Measurement Instruments

Exercise performance was measured by a symptom-limited, upright-cycle ergometer exercise test. Gas exchange was measured during the exercise test by using a Sensor Medics metabolic cart (Sylmar, California). The following exercise data were analyzed: $\dot{V}O_2$ and metabolic equivalents (% MET level). General health-related quality of life was measured by using the SF-36 (13). The SF-36 contains eight subscales that cover the domains of physical role, physical functioning, general health, bodily pain, vitality, social functioning, emotional role, and mental health. The subscales have been shown to have good internal consistency and

reliability; values for the Cronbach α statistic ranged from 0.76 to 0.88. Recently, two composite scores, the Physical Composite Summary Score and the Mental Composite Summary Score, have been recommended for analysis of SF-36 data. Both subscale and composite scores were calculated in this study.

Social support was measured with the Interpersonal Support Evaluation List (14), which consists of 40 statements on the perceived availability of social resources in 4 categories: tangible support, appraisal support, self-esteem support, and belonging support. Adequate internal reliability (values for the Cronbach α statistic ranged from 0.88 to 0.90) and test-retest reliability ($r = 0.87$) have been demonstrated for this scale. The State-Trait Anxiety Inventory includes separate 20-item self-report scales that measure state anxiety (influenced by situational factors) and trait anxiety (a stable, individual proneness). Both scales have a high degree of internal consistency, and evidence for the convergent and construct validity of the State-Trait Anxiety Inventory has been shown (15). The Health Services Utilization Questionnaire provides a comprehensive list of various health services and providers, along with their average costs, and allows the researcher to calculate a total cost per patient for use of services over a given period (16).

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MRI

**Sitting next to the technician
in the frigid control room
I watch thin slices of unremarkable brain
unfold on the screen.**

**Cerebellum, brainstem, thalamus,
cortex, then suddenly, softly, a pale
roundness emerges, a dimpled piece
of rotten fruit.**

**I shiver and look away into the glass cage
where my sister's legs protrude
from the huge machine, like a small animal
being swallowed head-first by a snake.**

**The MRI's thunderous rattle
shakes the ground beneath us, and
serpent-like, it spews out knowledge
of doom.**

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