A 12-year follow-up on the changes in health-related quality of life after coronary artery bypass graft surgery

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Received 26 February 2013; received in revised form 23 May 2013; accepted 31 May 2013

Abstract

OBJECTIVES: Improvement in quality of life (QoL) and survival benefit are the primary objectives of coronary artery bypass graft (CABG) surgery. The profile of patients undergoing isolated CABG has altered towards higher age with more preoperative comorbidities. Thus, the importance of QoL over the quantity of life among elderly patients is getting more emphasized. In this study, our main goal was to evaluate the long-term changes in QoL, overall performance status and symptomatic status after the CABG.

METHODS: Comprehensive data of 508 patients who underwent isolated CABG in a single institution were prospectively collected. The RAND-36 Health Survey (RAND-36) was used as an indicator of QoL. Karnofsky dependency category was used to evaluate overall performance status, and symptomatic status was assessed using New York Heart Association (NYHA) class. All assessment were made pre-operatively and repeated 1 year and 12 years later. The follow-up of the study cohort was complete in 95 and 84% of the alive patients at 1 year and 12 years, respectively. Analysis was based mainly on three age groups: ≤64 years (282 patients), 65–74 years (175 patients) and ≥75 years (17 patients).

RESULTS: Thirty-day, 1-year and 10-year survival rates were 98, 97 and 79%, respectively. Twelve years after the surgery significant improvement (P < 0.05) was seen in all but one RAND-36 dimensions of the QoL (general health, P = 0.76) as well as in functional capacity (P < 0.001) and NYHA class. All age groups showed improvements in RAND-36 physical component summary (PCS) and mental component summary (MCS) scores compared with the preoperative values. The youngest subgroup maintained their physical and mental health status best, whereas older subgroups had more pronounced decreases in their PCS and MCS scores.

CONCLUSIONS: Despite an ongoing deterioration 12 years after the CABG, there was significant improvement in most dimensions of the QoL and functional capacity in comparison with the preoperative values. The elderly gain less long-term benefit from CABG regarding the QoL and survival.

Keywords: Coronary artery bypass • Outcomes • Quality of life • Functional capacity • Elderly

INTRODUCTION

Improvement in quality of life (QoL) and survival benefit are the primary indications for coronary artery bypass graft (CABG) surgery [1]. During the past decades, the profile of patients undergoing isolated CABG operation has altered towards higher age with more preoperative comorbidities [2]. Especially in the elderly patients, whose life expectancy after surgery may be limited by natural factors, QoL has become an even more important issue when evaluating which patients will gain benefit from the CABG operation. Moreover, many patients give a higher importance for QoL over longer survival as the preferred therapeutic outcome [3, 4].

CABG surgery has been shown to reduce mortality [5] and cardiac-related symptoms [6]. However, this does not directly translate into health-related QoL, since a wide range of physical and mental dimensions are involved. Several risk indices have been developed for the prediction of postoperative mortality [7] and morbidity [8], but there is a limited amount of data available for clinicians to identify patients likely to experience improvement or deterioration in their long-term QoL following CABG operation. Although several publications have documented operative results and even the QoL in the elderly, there is a lack of data on long-term QoL in this group.

In our present prospective study, the main objective was to assess long-term changes in health-related QoL (RAND-36), overall performance status (Karnofsky score) and symptomatic status (New York Heart Association (NYHA) score) 12 years after CABG surgery. Special interest was focused on the elderly patients.

MATERIALS AND METHODS

The data were obtained from Tampere University Hospital between 2 May 1999 and 30 November 2000. The study was...
Preoperative clinical characteristics of the study population

<table>
<thead>
<tr>
<th>Risk factors</th>
<th>Study population, n = 508 (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male gender</td>
<td>420 (83%)</td>
</tr>
<tr>
<td>Mean age, years (SD)</td>
<td>62.3 (9.3)</td>
</tr>
<tr>
<td>Operative priority</td>
<td></td>
</tr>
<tr>
<td>Elective</td>
<td>398 (78%)</td>
</tr>
<tr>
<td>Urgent</td>
<td>110 (22%)</td>
</tr>
<tr>
<td>EuroSCORE, mean (SD)</td>
<td>2.7 (2.4)</td>
</tr>
<tr>
<td>Ejection fraction &lt;50%</td>
<td>93 (18%)</td>
</tr>
<tr>
<td>Left main stem ≥50%</td>
<td>107 (21%)</td>
</tr>
<tr>
<td>redo surgery</td>
<td>26 (5%)</td>
</tr>
<tr>
<td>Off-pump procedure</td>
<td>56 (11%)</td>
</tr>
<tr>
<td>Risk factors</td>
<td></td>
</tr>
<tr>
<td>Diabetes</td>
<td>74 (15%)</td>
</tr>
<tr>
<td>Hypertension</td>
<td>268 (53%)</td>
</tr>
<tr>
<td>Smoking</td>
<td>133 (26%)</td>
</tr>
<tr>
<td>BMI ≥ 30</td>
<td>100 (20%)</td>
</tr>
<tr>
<td>History of stroke</td>
<td>20 (4%)</td>
</tr>
<tr>
<td>Acute myocardial infarction within 90 days</td>
<td>68 (13%)</td>
</tr>
</tbody>
</table>

During the primary hospital stay, a comprehensive pre-, peri- and postoperative medical data body was collected. A summary of preoperative data is given in Table 1. Most patients were discharged postoperatively to the local district hospital and the data from these 18 secondary discharge hospitals were collected by referring physicians and sent to the authors for analysis. All outcome events and complications were recorded for the data from these 18 secondary discharge hospitals were collected by referring physicians and sent to the authors for analysis. All outcome events and complications were recorded for the data from these 18 secondary discharge hospitals were collected by referring physicians and sent to the authors for analysis. All outcome events and complications were recorded for the data from these 18 secondary discharge hospitals were collected by referring physicians and sent to the authors for analysis. All outcome events and complications were recorded for

Preoperative as well as 1-year and 12-year follow-up performance status was assessed using the Karnofsky scoring system (Table 2) [16]. Functional capacity was ranked according to the Karnofsky performance status scale.

This baseline self-report questionnaire was given to the patients the day before surgery. Emergently operated patients and those urgently operated who were unable to complete the survey were excluded from the study. The total number of patients undergoing CABG in our institution during study period was 1128. Of these, 508 (45%) completed the baseline survey. Excluded ones proved to be older (median age 68 vs 63, \( P < 0.001 \)), were operated more often urgently (47 vs 22%), were less often men (65 vs 83%, \( P < 0.001 \)) and had higher EuroSCORE 1 risk sum (median 4 vs 2, \( P < 0.001 \)).

The follow-up questionnaire was mailed to the patients 1 year and 12 years after the operation. Seventeen (3%) had died during the first postoperative year. Four hundred and sixty-five (95%) of the 491 surviving patients returned the 1-year follow-up questionnaire, mean time of follow-up being 12.6 (standard deviation (SD) 1.2) months. Compared with the 465 patients who completed the 1-year follow-up form, those 26 patients who did not complete it were younger (median age 54 vs 63 years, \( P = 0.006 \)) at the time of the operation. There were no significant differences in other variables including sex, EuroSCORE 1 risk sum, priority of operation or in the NYHA class.

Next time the same follow-up questionnaire was mailed to the participants 12 years after the operation. One hundred and eleven patients had died during this second period. Two hundred and ninety-six (84%) of the 354 surviving patients returned the follow-up questionnaire, mean time of follow-up being 11.8 (SD 0.48) years. Those who did not complete the form were an average 3 years older (median age 73 vs 70 years, \( P = 0.039 \)). Also, the other variables between the groups were closely equal.

RESULTS

Thirty-day, 1-year and 10-year survival rates were 98% (9 deaths), 97% (17 deaths) and 79% (107 deaths), respectively. Ten-year

Table 1: Preoperative clinical characteristics of the study population

| Study population, n = 508 (%) |

| Male gender                      | 420 (83%)          |
| Mean age, years (SD)             | 62.3 (9.3)         |
| Operative priority               |                    |
| Elective                         | 398 (78%)          |
| Urgent                           | 110 (22%)          |
| EuroSCORE, mean (SD)             | 2.7 (2.4)          |
| Ejection fraction <50%           | 93 (18%)           |
| Left main stem ≥50%              | 107 (21%)          |
| redo surgery                     | 26 (5%)            |
| Off-pump procedure               | 56 (11%)           |
| Risk factors                     |                    |
| Diabetes                         | 74 (15%)           |
| Hypertension                      | 268 (53%)          |
| Smoking                          | 133 (26%)          |
| BMI ≥ 30                         | 100 (20%)          |
| History of stroke                | 20 (4%)            |
| Acute myocardial infarction within 90 days | 68 (13%)          |

Table 2: Karnofsky performance status scale

| Needs institutional care          | 100% normal activity |
| At home; unable to work; can care for most personal needs | 90% minor symptoms |
|                                | 80% moderate symptoms |
|                                | 70% self-care, less than normal activity |
|                                | 60% need some help |
|                                | 50% need much help |
|                                | 40% disabled |
|                                | 20% need active support |
|                                | 10% moribund |
|                                | 0% dead |

We used the Finnish adaptation of the RAND-36 generic health-related QoL scale, for which there are reference values [13–15]. Functional capacity was ranked according to the Karnofsky performance status scale [16].
survival was a bit higher than in the age-, sex- and hospital-catchment-area-matched controls (77%). Fig. 1 shows Kaplan-Meier survival curves for different age groups. Thirty-day, 1-year and 10-year survival rates were associated with age ($P = 0.029$, $P = 0.095$ and $P < 0.001$); 99, 98 and 86% in the youngest, 98, 96 and 79% in the middle age and 94, 92 and 43% in the oldest age group, respectively.

The study patients had lower preoperative RAND-36 mean scores in all dimensions compared with the age- and sex-matched general Finnish population. One year after the surgery, all the health scores improved but they turned to fall in a later follow-up (Table 3). Twelve years after the CABG, significant improvements were seen in all but one RAND-36 dimensions (general health, $P = 0.76$). Above all, changes in physical role functioning and bodily pain were the most noteworthy. In the 12-year follow-up, the study population showed elevated health status in all the eight dimensions of RAND-36 compared with the age- and sex-matched general Finnish population (Table 3).

The mean changes in RAND-36 PCS and MCS scores with different age, sex, left ventricular function and diabetes status are given in Tables 4 and 5. All age groups improved PCS scores in the 1-year and 12-year follow-up compared with the preoperative scores. The youngest subgroup maintained their 12-year physical health status best, whereas older subgroups had a more pronounced decrease in their PCS scores. The same trend by different age groups was seen in MCS scores. Female patients had stronger decline in their PCS and MCS after 12 years. Diabetics appeared to reach lower PCS and MCS scores in comparison with non-diabetics after 1 year. They had also more emphasized decline in these summary scores during late follow-up.

Karnofsky performance status scores improved from preoperative 70 to 90% (mode) after the 12-year follow-up ($P < 0.001$, Fig. 2). In 59% of the patients, the Karnofsky score improved by at least 10%. Twelve years after the operation, 69% of the surviving patients had Karnofsky status ≥90%, indicating normal activity with no or minor symptoms. Patient age played a significant role in this, since only 44% of those aged ≥75 showed with Karnofsky 90% status vs 77% of those aged <65 years ($P = 0.007$). Patient sex, on the contrary, had no significant role in the magnitude of improvement.

Twelve years after the surgery, 90% of surviving patients obtained NYHA functional classes I or II. Over eighty percent (81%) of the surviving patients improved their NYHA status by at least one functional class. The freedom from severe anginal symptoms was closely equal (91 vs 92%) between those aged ≥75 years compared with those aged ≤64.

**DISCUSSION**

In this study, we evaluated the impact of CABG on the changes in QoL and functional capacity in a long term. Special interest was focused on the postoperative benefits for elderly patients. The proportion of elderly patients undergoing CABG has increased during past decades [2, 17]. Consequently, also the definition of elderly has gradually increased from 65 to 80 years or older. Several reports have shown that although short-term survival may be poorer [18], the long-term survival seems to be closely similar in elderly patients who undergo CABG compared with the population matched for age, sex and race [19]. Factors associated with survival and morbidity following CABG have been well-defined but there is a lack of long-term data regarding QoL, overall performance status and functional outcome in elderly patients. In our study, we set the age of 75 years as the lower cut-off for the oldest age group, since only 2% of the patients were ≥80 years old.

Many studies have showed positive impact of CABG on QoL in short- or mid-term follow-up [9, 15, 20]. There are only few reports available regarding long-term QoL after the CABG operation. The main finding of our study is that despite an ongoing deterioration, the QoL 12 years after CABG remained improved compared with preoperative values. There were significant improvements in seven of the eight dimensions of QoL. This finding is consistent with the findings of Herlitz et al. [21], who showed improvement in most aspects of QoL even 15 years after the surgery.

Effect of age on QoL after CABG has been controversial in the previous studies. Markou et al. [22] demonstrated that despite equal improvements in symptomatic status, patients over 75 years gained less benefit in QoL than younger age groups in 1-year follow-up. These findings are in line with our previous study reported in this journal [9]. On the other hand, Huber et al. [23] reported remarkable improvements in QoL and functional status 2 years after cardiac surgery regardless of age. We found that in the oldest subgroup the decline of QoL scores was more pronounced, whereas the youngest subgroup maintained their health status best. Similar trend was seen in both physical and mental component scores. Moreover, older subgroups achieved lower PCS and MCS scores in the 1-year follow-up and 12-year follow-up. Even though the oldest subgroup presented lower values in QoL, all age groups showed improvement in their QoL in comparison with preoperative values.

A large variety of health measurement tools have been developed over the last decades for evaluation of health-related QoL [24]. We chose the Finnish version of the RAND-36 generic health survey questionnaire, since it has been carefully adapted to
### Table 3: QoL scores (RAND-36) for survivors and general population

<table>
<thead>
<tr>
<th>QoL category</th>
<th>Baseline, n = 508</th>
<th>1-year follow-up, n = 465</th>
<th>12-year follow-up, n = 296</th>
<th>General populationa</th>
<th>Changeb</th>
<th>P-valuesc</th>
</tr>
</thead>
<tbody>
<tr>
<td>General health</td>
<td>54.2</td>
<td>56.0</td>
<td>54.5</td>
<td>46.7</td>
<td>+0.3</td>
<td>0.76</td>
</tr>
<tr>
<td>Physical functioning</td>
<td>51.7</td>
<td>73.9</td>
<td>65.8</td>
<td>58.7</td>
<td>+14.1</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Social functioning</td>
<td>67.4</td>
<td>81.2</td>
<td>77.8</td>
<td>75.7</td>
<td>+10.4</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Role functioning/physical</td>
<td>24.4</td>
<td>54.3</td>
<td>51.8</td>
<td>39.1</td>
<td>-27.4</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Role functioning/emotional</td>
<td>44.5</td>
<td>65.2</td>
<td>61.0</td>
<td>51.3</td>
<td>+16.5</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Emotional well-being</td>
<td>73.9</td>
<td>76.7</td>
<td>76.3</td>
<td>71.8</td>
<td>+2.4</td>
<td>0.032</td>
</tr>
<tr>
<td>Energy</td>
<td>58.4</td>
<td>66.3</td>
<td>63.5</td>
<td>59.4</td>
<td>+5.1</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Pain</td>
<td>51.8</td>
<td>74.5</td>
<td>71.9</td>
<td>63.5</td>
<td>+20.1</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

aAge- and sex-adjusted reference values for 12-year follow-up scores.
bBetween 12-year and baseline scores.
cPaired-samples t test between the baseline and 12-year follow-up scores.

### Table 4: Mean change in RAND-36 PCS scores with different age, sex, left ventricular function and diabetes status

<table>
<thead>
<tr>
<th>Group</th>
<th>Baseline</th>
<th>1 year</th>
<th>12 years</th>
<th>P-values*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Interaction between time × group</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
<td></td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>&lt;64</td>
<td>47.8</td>
<td>69.1</td>
<td>68.0</td>
<td></td>
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<tr>
<td>65–75</td>
<td>39.6</td>
<td>67.1</td>
<td>47.7</td>
<td></td>
</tr>
<tr>
<td>&gt;75</td>
<td>42.7</td>
<td>56.8</td>
<td>45.1</td>
<td></td>
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<tr>
<td><strong>Sex</strong></td>
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<td></td>
<td></td>
<td>0.32</td>
</tr>
<tr>
<td>Male</td>
<td>46.1</td>
<td>69.2</td>
<td>62.6</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>40.3</td>
<td>62.3</td>
<td>52.3</td>
<td></td>
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<tr>
<td><strong>Left ventricular function</strong></td>
<td></td>
<td></td>
<td></td>
<td>0.088</td>
</tr>
<tr>
<td>EF ≤ 50</td>
<td>43.3</td>
<td>69.2</td>
<td>54.3</td>
<td></td>
</tr>
<tr>
<td>EF &gt; 50</td>
<td>45.6</td>
<td>68.0</td>
<td>61.7</td>
<td></td>
</tr>
<tr>
<td><strong>Diabetes</strong></td>
<td></td>
<td></td>
<td></td>
<td>0.001</td>
</tr>
<tr>
<td>Yes</td>
<td>41.1</td>
<td>54.6</td>
<td>41.0</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>45.5</td>
<td>69.4</td>
<td>62.9</td>
<td></td>
</tr>
</tbody>
</table>

*Variance analysis for repeated measures.

### Table 5: Mean change in RAND-36 MCS scores with different age, sex, left ventricular function and diabetes status

<table>
<thead>
<tr>
<th>Group</th>
<th>Baseline</th>
<th>1 year</th>
<th>12 years</th>
<th>P-values*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Interaction between time × group</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
<td></td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>&lt;64</td>
<td>62.0</td>
<td>74.0</td>
<td>74.1</td>
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<tr>
<td>65–75</td>
<td>59.3</td>
<td>76.0</td>
<td>58.6</td>
<td></td>
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<tr>
<td>&gt;75</td>
<td>56.9</td>
<td>73.1</td>
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<tr>
<td><strong>Sex</strong></td>
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<tr>
<td>Male</td>
<td>61.7</td>
<td>74.6</td>
<td>70.5</td>
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<tr>
<td>Female</td>
<td>58.0</td>
<td>74.7</td>
<td>61.3</td>
<td></td>
</tr>
<tr>
<td><strong>Left ventricular function</strong></td>
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<td></td>
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<td>0.13</td>
</tr>
<tr>
<td>EF ≤ 50</td>
<td>61.6</td>
<td>80.4</td>
<td>67.7</td>
<td></td>
</tr>
<tr>
<td>EF &gt; 50</td>
<td>61.2</td>
<td>74.2</td>
<td>68.8</td>
<td></td>
</tr>
<tr>
<td><strong>Diabetes</strong></td>
<td></td>
<td></td>
<td></td>
<td>0.19</td>
</tr>
<tr>
<td>Yes</td>
<td>59.8</td>
<td>66.4</td>
<td>61.1</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>61.1</td>
<td>75.5</td>
<td>69.7</td>
<td></td>
</tr>
</tbody>
</table>

*Variance analysis for repeated measures.
Finnish population and yields age- and sex-adjusted reference values for Finnish population. These population-based reference values derive from randomly selected sample from the Finnish Population Register [10].

Karnofsky dependency classification was used to explore the degree of help needed by the patients before and after CABG. The Karnofsky performance status scale was originally designed to assess overall performance status and functional impairment in cancer patients [16], but it has since been used in cardiac patients by some authors [25]. In our study, Karnofsky dependency classification revealed that over 95% of the patients had improved functional status 12 years after surgery compared with preoperative status. Moreover, 12 years after operation, 69% of the patients had a Karnofsky status of 90%, indicating normal activity and independent functioning in daily activities with no or minor symptoms.

Our study has several limitations. First, all emergency treatment patients and those who were unable to complete the baseline survey prior to the CABG had to be excluded. Although we could partly control the effects of selection by comparing the baseline data between the studied individuals and those whom QoL data were not available, the selection bias due to incomplete recruitment may limit the generalization of our results mainly to electively and urgently operated patients. The follow-up of the study cohort, on the other hand, was complete in 95 and 84% of the alive patients at 1 year and 12 years, respectively. Except for younger age at 1-year follow-up, no other differences were found between the non-responders and responders in preoperative clinical characteristics. Secondy, selection bias may also have been caused by the assumption that the patients who survived >12 years may have had better physical and mental activity than those who died earlier. This could partly explain why the QoL is higher in the CABG group in comparison with the Finnish reference population. Thirdly, in such a long follow-up period, other comorbidities besides cardiac-related factors may have influenced patient QoL and overall performance status. For this reason, we compared patient’s RAND-36 values with age- and sex-matched individuals. Finally, because of restricted life expectancy due to natural age-related factors and comorbidities in the oldest subgroup, the final number of the analysed elderly proved to be relative small.

In conclusion, despite an ongoing deterioration 12 years after the coronary artery bypass grafting, there is significant improvement in most QoL dimensions and functional capacity in comparison with preoperative values. The elderly gain less benefit than younger patients in long-term survival and QoL, although their long-term health status remained improved compared with the preoperative state.

Conflict of interest: none declared.

REFERENCES


