Symptoms of chest pain and dyspnoea during a period of 15 years after coronary artery bypass grafting

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Abstract

Aim: To describe changes in chest pain and dyspnoea during a period of 15 years after coronary artery bypass grafting (CABG) and to define factors at the time of operation that were associated with the occurrence of these symptoms after 15 years. Design: Prospective observational study in western Sweden. Subjects: All patients who underwent first-time CABG, without simultaneous valve surgery, between 1 June 1988 and 1 June 1991. There were no exclusion criteria. Follow-up: All patients were followed up prospectively for 15 years. The evaluation of symptoms took place through postal questionnaires prior to and 5, 10 and 15 years after the operation. Results: Totally, 2000 patients were included in the survey and 904 (45%) of them survived to 15 years. Among these 904 survivors, the percentage of patients with chest pain increased from 44% to 50% between the 5- and 15-year follow-up (p = 0.004). The percentage of patients who reported symptoms of dyspnoea increased from 60% after 5 years to 74% after 15 years (p < 0.001). Factors at the time of surgery that independently tended to predict chest pain after 15 years were higher age (p = 0.04) and prolonged duration of symptoms prior to surgery (p = 0.04). Predictors of dyspnoea after 15 years were higher age (p < 0.0001), the use of inotropic drugs at the time of surgery (p = 0.001), a history of diabetes (p = 0.01) and obesity (p = 0.01). Conclusion: After CABG, relief from chest pain and dyspnoea is generally maintained over a long period of time. Eventually, however, functional-limiting symptoms tend to recur and about half the patients report symptoms of chest pain, while three-quarters report dyspnoea after 15 years. Even if no clear predictor of chest pain was found at the time of surgery, age, the use of inotropic drugs, diabetes and obesity predicted dyspnoea.

Keywords: Chest pain; Dyspnoea; Coronary artery bypass grafting

1. Introduction

A large percentage of patients with ischaemic heart disease undergo coronary re-vascularisation to improve the prognosis [1] and relieve symptoms [2,3]. A number of studies have shown that, during the first 5–10 years after surgery, the symptoms improve dramatically. The underlying atherosclerotic disease is, however, likely to progress and, in a long-term perspective, the risk of disease-related symptoms recurring is obvious [4]. This is not well described in the literature, as studies of outcome after coronary artery bypass grafting (CABG) beyond 10 years are lacking.

We thought it was important for health-care providers to know: (1) What extent of heart-related symptoms such as chest pain and dyspnoea could be expected if one survives 15 years after CABG? (2) Is it possible to forecast such symptoms among those who survive for a very long time after CABG already at the time of surgery? If so, specific attention could be paid to these high-risk groups and various interventions be tested in the future to improve the situation in the long-term perspective in these patients.

This survey aims to describe (1) the occurrence of the most common symptoms in ischaemic heart disease, that is, chest pain and dyspnoea, during a period of 15 years after CABG in a representative population of patients who underwent CABG in western Sweden and (2) to define factors at the time of the operation that were associated with the occurrence of these symptoms after 15 years.

2. Methods

2.1. Patient population

Between June 1988 and June 1991, all the patients from western Sweden who underwent CABG at the Department of
Thoracic and Cardiovascular Surgery at the Sahlgrenska University Hospital and at the Scandinavian Heart Centre in Göteborg were registered prospectively. These two hospitals performed all cardiac surgery in the western health-care region of Sweden with a population of about 1,600,000 at the time. Thus, all CABG operations that took place at the time of the survey in the region are included in the register. For participation in the present analysis the only exclusion criterion was simultaneous valve surgery or previous CABG (n = 365). All the patients were followed for at least 15 years after CABG, except for 11 patients who emigrated during the follow-up period.

In general, the selection of patients for CABG during the study period was based on the following criteria: the presence of angina pectoris despite maximum medical therapy, a positive exercise test, a coronary angiogram with more than 50% stenosis in vessel segments with a diameter of 1 mm or more and a coronary anatomy not suitable for percutaneous transluminal coronary angioplasty (PTCA). A responsible cardiologist and a thoracovascular surgeon made the decision to perform CABG by consensus.

The mean time on the waiting list between coronary angiography and CABG was 107 days.

2.2. Previous history

A member of the research team interviewed all patients 4—7 days after the operation. Information about previous history was collected from this interview and from hospital medical records.

Renal function was calculated on the day prior to CABG using the formula adapted from Cockcroft and Gault [5], which estimates creatinine clearance (\( C_{\text{CR}} \)) on the basis of serum creatinine (\( S_{\text{CREA}} \)):

\[
C_{\text{CR}} = \frac{(140 - \text{age}) \times \text{weight}/(S_{\text{CREA}} \times 72)}{85}
\]

for men and

\[
C_{\text{CR}} = \frac{(140 - \text{age}) \times \text{weight}/S_{\text{CREA}}}{85}
\]

for women. \( C_{\text{CR}} \) is given in millilitres per minute, age in years, weight in kilograms and \( S_{\text{CREA}} \) in milligrams per decilitre. Renal dysfunction was defined as a \( C_{\text{CR}} \) below 60 ml min\(^{-1}\).

Obesity was defined as a body mass index greater than or equal to 30 kg m\(^{-2}\) [6].

Current smoking was defined as smoking at least one cigarette a day within 3 months prior to operation.

2.3. Evaluation of symptoms

Information on symptoms was obtained from self-administered questionnaires at the time of coronary angiography (mean of 3.6 months prior to the operation) and again at 5, 10 and 15 years after surgery. Patients were asked to report on their level of physical activity and to describe activity-limiting symptoms. They were also asked about the occurrence and frequency of various types of chest pain and dyspnoea. The questionnaires were modified from Rose et al. [7] and validated with respect to dyspnoea [8,9] and chest pain [9,10]. Modifications involved the translation and addition of complementary questions, and validations were performed in connection with the previous population studies evaluating clinical signs [8] and left ventricular wall motion abnormalities [9] in cardiac dyspnoea and prognosis in patients with chest pain [10].

Patients were asked whether they were able to perform various physical activities, including walking, dressing, working in the home and garden and taking exercise, and, if not, to describe the activity-limiting symptom. In the general results, we present data on chest pain without considering the cause. In Table 5, however, angina pectoris is defined according to different criteria, and, in the multivariate analyses, angina pectoris was classified as chest pain or discomfort when walking uphill or in a hurry. One investigator (M.H.) administered the questionnaire prior to and after surgery.

2.4. Operative factors

Information on several aspects relating to the CABG operation was collected prospectively. First, the urgency of the operation was graded: 1. outpatients on the waiting list; 2. inpatients scheduled for surgery; 3. inpatients with ongoing nitroglycerine infusion; 4. patients referred to surgery directly from the cath lab; 5. patients with an ongoing acute myocardial infarction; 6. patients with an ongoing cardiac arrest. Second, the following surgical procedures were registered: 1. ECC time; 2. aortic cross-clamp time; 3. number of distal anastomoses; 4. IMA grafting; and 5. endarterectomy. Finally, postoperative complications were categorised as follows: (1) conditions requiring reoperation (mainly bleeding); (2) neurological complications; (3) pneumothorax; (4) arrhythmias requiring treatment; (5) circulatory insufficiency requiring inotropic drugs; and (6) circulatory insufficiency requiring assistance devices.

2.5. Statistical methods

To test for differences between time points, Wilcoxon’s signed-rank test was used for ordered data and the sign test was used for dichotomous variables. Only complete pairs of data were used in the p-value calculations. We did not use a full repeated-measures model because of the substantial loss of information this would entail, as fewer than 400 patients answered the questionnaire at all four points in time.

To identify independent risk factors for chest pain (defined as three or more attacks of chest pain per week) and dyspnoea (defined as symptoms of breathlessness at rest or during exertion with the exception of walking uphill or quickly on level ground), respectively, 15 years after the operation, we applied the following strategy for each of the end-points (chest pain/dyspnoea at 15 years). First, we univariately tested variables for associations with the end-points using the chi-square and Mann—Whitney U tests. The variables that were tested were preoperative factors (i.e., all the variables in Table 1, plus height, weight, body surface area and stenosis of the proximal left anterior descending vessel) as well as perioperative factors (i.e., urgency of operation, ECC time, aortic cross-clamp time, number of distal anastomoses, IMA grafting, endarterectomy, time in ICU, ventilator time, need for re-operation, neurological complications, pneumothorax, hydrothorax, supraventricular arrhythmia, need for inotropic drugs, prolonged reperfusion in a heart—lung machine, need for circulatory assistance devices and S-ASAT maximum within 48 h). All variables with
p < 0.05 in the univariate analyses were then tested for inclusion in a forward stepwise logistic regression model to identify independent predictors of chest pain and dyspnoea, respectively.

For these multivariate analyses, we used 0.05 as the significance level. For all the other analyses, the significance level was 0.01.

All p-values were two-tailed and were not corrected for multiple testing.

3. Results

In total, 2000 patients met the inclusion and exclusion criteria and were considered eligible for the survey. Of these, 45% (n = 904) were still alive 15 years after surgery. Prior to surgery, 61% of the total study population responded to the inquiry and, at 5, 10 and 15 years of follow-up, the response rates were 78%, 71% and 71%, respectively. Table 1 shows the clinical characteristics at baseline (i.e., at the time of surgery) for the total CABG population and the subgroups of patients who responded to the inquiry at different time points. Patients who responded after 15 years were somewhat younger than the total CABG population and were less likely to be in the NYHA functional class IV and have an ejection fraction below 40%. Otherwise, the baseline characteristics for the various cohorts of responders were fairly similar to those of the total CABG group.

3.1. Physical activity during 15 years of follow-up (Table 2)

Limitation of physical activity decreased markedly after surgery and the improvement in physical performance continued during the 15 years of follow-up. However, functional limitations became more prominent over time and patients reporting no limitation of physical activity decreased from 39% after 5 years to 25% after 15 years. Activity limitation due to tiredness increased the most, whereas restrictions due to palpitations and dyspnoea increased less and limitations due to chest pain did not change at all after the 5-year inquiry.

3.2. Chest pain on various occasions during 15 years (Table 3)

The high recovery rate from chest pain continued throughout the 15-year follow-up after CABG. However, the percentage of patients reporting chest pain increased slightly over time, from 44% after 5 years to 50% after 15 years (p = 0.004). A higher percentage of chest pain was reported in most situations, with the exception of chest pain
### Table 2
Physical activity prior to and 5, 10 and 15 years after the operation.

<table>
<thead>
<tr>
<th></th>
<th>Preoperative</th>
<th>5 years postoperative</th>
<th>10 years postoperative</th>
<th>15 years postoperative</th>
<th>Change&lt;sup&gt;d&lt;/sup&gt; (5 vs 10)</th>
<th>Change&lt;sup&gt;d&lt;/sup&gt; (5 vs 15)</th>
<th>Change&lt;sup&gt;d&lt;/sup&gt; (10 vs 15)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical activity not limited</td>
<td>38</td>
<td>38</td>
<td>38</td>
<td>38</td>
<td>p &lt; 0.0001&lt;sup&gt;b,c&lt;/sup&gt;</td>
<td>p &lt; 0.0001</td>
<td>p &lt; 0.0001</td>
</tr>
<tr>
<td>Physical activity slightly limited</td>
<td>21</td>
<td>21</td>
<td>21</td>
<td>21</td>
<td>p &lt; 0.0001&lt;sup&gt;b,c&lt;/sup&gt;</td>
<td>p &lt; 0.0001</td>
<td>p &lt; 0.0001</td>
</tr>
<tr>
<td>Physical activity severely limited</td>
<td>40</td>
<td>40</td>
<td>40</td>
<td>40</td>
<td>p &lt; 0.0001&lt;sup&gt;b,c&lt;/sup&gt;</td>
<td>p &lt; 0.0001</td>
<td>p &lt; 0.0001</td>
</tr>
<tr>
<td>Unable to perform physical activity</td>
<td>78</td>
<td>78</td>
<td>78</td>
<td>78</td>
<td>p &lt; 0.0001&lt;sup&gt;b,c&lt;/sup&gt;</td>
<td>p &lt; 0.0001</td>
<td>p &lt; 0.0001</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>5 years postoperative</th>
<th>10 years postoperative</th>
<th>15 years postoperative</th>
<th>Change&lt;sup&gt;d&lt;/sup&gt; (5 vs 10)</th>
<th>Change&lt;sup&gt;d&lt;/sup&gt; (5 vs 15)</th>
<th>Change&lt;sup&gt;d&lt;/sup&gt; (10 vs 15)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical activity not limited</td>
<td>38</td>
<td>38</td>
<td>38</td>
<td>p &lt; 0.0001&lt;sup&gt;b,c&lt;/sup&gt;</td>
<td>p &lt; 0.0001</td>
<td>p &lt; 0.0001</td>
</tr>
<tr>
<td>Physical activity slightly limited</td>
<td>21</td>
<td>21</td>
<td>21</td>
<td>p &lt; 0.0001&lt;sup&gt;b,c&lt;/sup&gt;</td>
<td>p &lt; 0.0001</td>
<td>p &lt; 0.0001</td>
</tr>
<tr>
<td>Physical activity severely limited</td>
<td>40</td>
<td>40</td>
<td>40</td>
<td>p &lt; 0.0001&lt;sup&gt;b,c&lt;/sup&gt;</td>
<td>p &lt; 0.0001</td>
<td>p &lt; 0.0001</td>
</tr>
<tr>
<td>Unable to perform physical activity</td>
<td>78</td>
<td>78</td>
<td>78</td>
<td>p &lt; 0.0001&lt;sup&gt;b,c&lt;/sup&gt;</td>
<td>p &lt; 0.0001</td>
<td>p &lt; 0.0001</td>
</tr>
</tbody>
</table>

* Percentages refer to all data available.
<sup>b</sup> Refers to the ordered distribution of degree of physical limitation.
<sup>c</sup> p-values refer to changes from preoperative (only complete pairs of data are used in calculations of p-values, given if below 0.01).
<sup>d</sup> Refer to change between different time points (only complete pairs of data are used in calculations of p-values, given if below 0.01).

### Table 3
Chest pain on various occasions prior to and five, 10 and 15 years after the operation.

<table>
<thead>
<tr>
<th></th>
<th>Preoperative</th>
<th>5 years postoperative</th>
<th>10 years postoperative</th>
<th>15 years postoperative</th>
<th>Change&lt;sup&gt;b&lt;/sup&gt; (5 vs 10)</th>
<th>Change&lt;sup&gt;b&lt;/sup&gt; (5 vs 15)</th>
<th>Change&lt;sup&gt;b&lt;/sup&gt; (10 vs 15)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No chest pain</td>
<td>38</td>
<td>38</td>
<td>38</td>
<td>38</td>
<td>p &lt; 0.0001&lt;sup&gt;b,c&lt;/sup&gt;</td>
<td>p &lt; 0.0001</td>
<td>p &lt; 0.0001</td>
</tr>
<tr>
<td>When walking uphill or quickly on level ground</td>
<td>94</td>
<td>94</td>
<td>94</td>
<td>94</td>
<td>p &lt; 0.0001&lt;sup&gt;b,c&lt;/sup&gt;</td>
<td>p &lt; 0.0001</td>
<td>p &lt; 0.0001</td>
</tr>
<tr>
<td>When walking with people of own age on the level at their speed</td>
<td>90</td>
<td>90</td>
<td>90</td>
<td>90</td>
<td>p &lt; 0.0001&lt;sup&gt;b,c&lt;/sup&gt;</td>
<td>p &lt; 0.0001</td>
<td>p &lt; 0.0001</td>
</tr>
<tr>
<td>When walking on the level at own speed</td>
<td>35</td>
<td>35</td>
<td>35</td>
<td>35</td>
<td>p &lt; 0.0001&lt;sup&gt;b,c&lt;/sup&gt;</td>
<td>p &lt; 0.0001</td>
<td>p &lt; 0.0001</td>
</tr>
<tr>
<td>When dressing or washing</td>
<td>27</td>
<td>27</td>
<td>27</td>
<td>27</td>
<td>p &lt; 0.0001&lt;sup&gt;b,c&lt;/sup&gt;</td>
<td>p &lt; 0.0001</td>
<td>p &lt; 0.0001</td>
</tr>
<tr>
<td>At rest, when sitting down</td>
<td>17</td>
<td>17</td>
<td>17</td>
<td>17</td>
<td>p &lt; 0.0001&lt;sup&gt;b,c&lt;/sup&gt;</td>
<td>p &lt; 0.0001</td>
<td>p &lt; 0.0001</td>
</tr>
<tr>
<td>At night</td>
<td>33</td>
<td>33</td>
<td>33</td>
<td>33</td>
<td>p &lt; 0.0001&lt;sup&gt;b,c&lt;/sup&gt;</td>
<td>p &lt; 0.0001</td>
<td>p &lt; 0.0001</td>
</tr>
<tr>
<td>When under stress</td>
<td>86</td>
<td>86</td>
<td>86</td>
<td>86</td>
<td>p &lt; 0.0001&lt;sup&gt;b,c&lt;/sup&gt;</td>
<td>p &lt; 0.0001</td>
<td>p &lt; 0.0001</td>
</tr>
<tr>
<td>After dinner</td>
<td>35</td>
<td>35</td>
<td>35</td>
<td>35</td>
<td>p &lt; 0.0001&lt;sup&gt;b,c&lt;/sup&gt;</td>
<td>p &lt; 0.0001</td>
<td>p &lt; 0.0001</td>
</tr>
<tr>
<td>When out in cold or windy weather</td>
<td>84</td>
<td>84</td>
<td>84</td>
<td>84</td>
<td>p &lt; 0.0001&lt;sup&gt;b,c&lt;/sup&gt;</td>
<td>p &lt; 0.0001</td>
<td>p &lt; 0.0001</td>
</tr>
</tbody>
</table>

* Percentages refer to all data available.
<sup>b</sup> Refer to change between different time points (only complete pairs of data are used in calculations of p-values, given if below 0.01).

### Table 4
Number of attacks of chest pain prior to and 5 and 10 years after the operation.

<table>
<thead>
<tr>
<th></th>
<th>Preoperative</th>
<th>5 years postoperative</th>
<th>10 years postoperative</th>
<th>15 years postoperative</th>
<th>Change&lt;sup&gt;b&lt;/sup&gt; (5 vs 10)</th>
<th>Change&lt;sup&gt;b&lt;/sup&gt; (5 vs 15)</th>
<th>Change&lt;sup&gt;b&lt;/sup&gt; (10 vs 15)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of attacks</td>
<td>38</td>
<td>38</td>
<td>38</td>
<td>38</td>
<td>p &lt; 0.0001&lt;sup&gt;b,c&lt;/sup&gt;</td>
<td>p &lt; 0.0001</td>
<td>p &lt; 0.0001</td>
</tr>
<tr>
<td>None</td>
<td>38</td>
<td>38</td>
<td>38</td>
<td>38</td>
<td>p &lt; 0.0001&lt;sup&gt;b,c&lt;/sup&gt;</td>
<td>p &lt; 0.0001</td>
<td>p &lt; 0.0001</td>
</tr>
<tr>
<td>Less than once a week</td>
<td>94</td>
<td>94</td>
<td>94</td>
<td>94</td>
<td>p &lt; 0.0001&lt;sup&gt;b,c&lt;/sup&gt;</td>
<td>p &lt; 0.0001</td>
<td>p &lt; 0.0001</td>
</tr>
<tr>
<td>1–2 per week</td>
<td>90</td>
<td>90</td>
<td>90</td>
<td>90</td>
<td>p &lt; 0.0001&lt;sup&gt;b,c&lt;/sup&gt;</td>
<td>p &lt; 0.0001</td>
<td>p &lt; 0.0001</td>
</tr>
<tr>
<td>3–6 per week</td>
<td>35</td>
<td>35</td>
<td>35</td>
<td>35</td>
<td>p &lt; 0.0001&lt;sup&gt;b,c&lt;/sup&gt;</td>
<td>p &lt; 0.0001</td>
<td>p &lt; 0.0001</td>
</tr>
<tr>
<td>Once or twice daily</td>
<td>86</td>
<td>86</td>
<td>86</td>
<td>86</td>
<td>p &lt; 0.0001&lt;sup&gt;b,c&lt;/sup&gt;</td>
<td>p &lt; 0.0001</td>
<td>p &lt; 0.0001</td>
</tr>
<tr>
<td>Several attacks daily</td>
<td>35</td>
<td>35</td>
<td>35</td>
<td>35</td>
<td>p &lt; 0.0001&lt;sup&gt;b,c&lt;/sup&gt;</td>
<td>p &lt; 0.0001</td>
<td>p &lt; 0.0001</td>
</tr>
</tbody>
</table>

* Percentages refer to all data available.
<sup>b</sup> Refers to the ordered distribution of degree of frequency of attacks.
<sup>c</sup> p-values refer to changes from preoperative (only complete pairs of data are used in calculations of p-values, given if below 0.01).
<sup>d</sup> p-values refer to changes from preoperative (only complete pairs of data are used in calculations of p-values).
at rest, at night and after dinner, when no significant change was found.

3.3. Number of attacks of chest pain during 15 years

(Table 4)

The distribution of patients with respect to the number of chest pain attacks changed only modestly after 5 years, and there was no significant change between 10 and 15 years after the operation.

3.4. Angina pectoris during 15 years (Table 5)

The percentage of patients with chest pain interpreted as angina pectoris increased only modestly between the 5- and 10-year surveys, and there was no significant change between 10 and 15 years of follow-up.

3.5. Dyspnoea during 15 years (Table 6)

The prevalence of dyspnoea decreased markedly following CABG and remained at a lower level than prior to surgery throughout follow-up. However, the percentage of patients with dyspnoea increased over time from 60% after 5 years to 74% after 15 years (p < 0.0001). The percentage of patients reporting dyspnoea increased significantly in most situations, with the exception of dyspnoea at rest, when sitting down and at night.

3.6. Independent predictors of chest pain and dyspnoea

(Table 7)

There were only two baseline factors that tended to be associated with chest pain after 15 years: duration of symptoms and age.

Independent baseline predictors of dyspnoea after 15 years were age, the use of inotropic drugs at the time of the operation, a history of diabetes and obesity.

3.7. Rate and mode of death

Table 8 shows the survival during 15 years among all operated patients and patients who did not respond to any of the questionnaires.

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**Table 5**

Angina pectoris according to questionnaire prior to and 5, 10 and 15 years after the operation.

<table>
<thead>
<tr>
<th>Operation</th>
<th>Preoperative (n = 1226) (%)</th>
<th>5 years postoperative (n = 1359) (%)</th>
<th>10 years postoperative (n = 976) (%)</th>
<th>15 years postoperative (n = 639) (%)</th>
<th>Change&lt;sub&gt;b&lt;/sub&gt; (5 vs 10)</th>
<th>Change&lt;sub&gt;b&lt;/sub&gt; (5 vs 15)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recent chest pain</td>
<td>97</td>
<td>44</td>
<td>46</td>
<td>50</td>
<td>p = 0.004</td>
<td></td>
</tr>
<tr>
<td>Pain or discomfort when</td>
<td>93</td>
<td>33</td>
<td>37</td>
<td>39</td>
<td>p &lt; 0.0001</td>
<td>p &lt; 0.0001</td>
</tr>
<tr>
<td>walking uphill or in a hurry</td>
<td>93</td>
<td>31</td>
<td>36</td>
<td>38</td>
<td>p &lt; 0.0001</td>
<td>p &lt; 0.0001</td>
</tr>
<tr>
<td>Pain goes away when</td>
<td>74</td>
<td>28</td>
<td>33</td>
<td>35</td>
<td>p &lt; 0.0001</td>
<td>p &lt; 0.0001</td>
</tr>
<tr>
<td>standing still</td>
<td>65</td>
<td>24</td>
<td>29</td>
<td>30</td>
<td>p = 0.0002</td>
<td>p = 0.0009</td>
</tr>
<tr>
<td>Pain goes away within 10 min</td>
<td>65</td>
<td>24</td>
<td>29</td>
<td>30</td>
<td>p = 0.0002</td>
<td>p = 0.0009</td>
</tr>
</tbody>
</table>

* * *

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**Table 6**

Symptoms of dyspnoea on various occasions prior to and five, 10 and 15 years after the operation.

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Preoperative (n = 1226) (%)</th>
<th>5 years postoperative (n = 1359) (%)</th>
<th>10 years postoperative (n = 976) (%)</th>
<th>15 years postoperative (n = 639) (%)</th>
<th>Change&lt;sub&gt;c&lt;/sub&gt; (5 vs 10)</th>
<th>Change&lt;sub&gt;c&lt;/sub&gt; (5 vs 15)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No dyspnoea</td>
<td>12</td>
<td>40 (p &lt; 0.0001)</td>
<td>31 (p &lt; 0.0001)</td>
<td>26 (p &lt; 0.0001)</td>
<td>p &lt; 0.0001</td>
<td>p &lt; 0.0001</td>
</tr>
<tr>
<td>When walking uphill or quickly on level ground</td>
<td>85</td>
<td>56 (p &lt; 0.0001)</td>
<td>65 (p &lt; 0.0001)</td>
<td>69 (p &lt; 0.0001)</td>
<td>p &lt; 0.0001</td>
<td>p &lt; 0.0001</td>
</tr>
<tr>
<td>When breathing when with people of own age on the level at their speed</td>
<td>70</td>
<td>35 (p &lt; 0.0001)</td>
<td>43 (p &lt; 0.0001)</td>
<td>49 (p &lt; 0.0001)</td>
<td>p &lt; 0.0001</td>
<td>p &lt; 0.0001</td>
</tr>
<tr>
<td>Have to stop and catch breath when walking on the level at own speed</td>
<td>36</td>
<td>14 (p &lt; 0.0001)</td>
<td>19 (p &lt; 0.0001)</td>
<td>25</td>
<td>p &lt; 0.0001</td>
<td>p &lt; 0.0001</td>
</tr>
<tr>
<td>When dressing or washing</td>
<td>24</td>
<td>10 (p &lt; 0.0001)</td>
<td>13 (p &lt; 0.0001)</td>
<td>14</td>
<td>p &lt; 0.0001</td>
<td>p &lt; 0.0001</td>
</tr>
<tr>
<td>At rest, when sitting down or at night</td>
<td>12</td>
<td>4 (p &lt; 0.0001)</td>
<td>5 (p &lt; 0.0001)</td>
<td>5</td>
<td>p &lt; 0.0001</td>
<td>p &lt; 0.0007</td>
</tr>
<tr>
<td>Have to sit down and rest when returning from a walk</td>
<td>65</td>
<td>34 (p &lt; 0.0001)</td>
<td>42 (p &lt; 0.0001)</td>
<td>52</td>
<td>p &lt; 0.0001</td>
<td>p &lt; 0.0001</td>
</tr>
<tr>
<td>Wake up at night due to dyspnoea</td>
<td>17</td>
<td>7 (p &lt; 0.0001)</td>
<td>8 (p &lt; 0.0001)</td>
<td>7 (p &lt; 0.0001)</td>
<td>p &lt; 0.0009</td>
<td></td>
</tr>
</tbody>
</table>

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* a Percentages refer to all data available.
* b p-values refer to changes from preoperative (only complete pairs of data are used in calculations of p-values, given if below 0.01).
* c Refer to change between different time points (only complete pairs of data are used in calculations of p-values, given if below 0.01).
Data on the mode of death during the first 10 years among all patients and non-responders are also tabulated.

4. Discussion

This study demonstrates that symptom relief achieved by CABG in patients with ischaemic heart disease largely persists during a long-term follow-up period of 15 years. Although 55% of patients died during the follow-up period, this should be related to the fact that the mean age of the patients at the time of surgery was 64 years. We have recently reported that the long-term mortality after CABG does not differ markedly from that of an age- and gender-matched control population [11].

After a marked improvement in chest pain following CABG, there were only modest changes in the occurrence of this symptom during long-term follow-up. In fact, the percentage of patients with physical limitations due to chest pain did not change at all. However, this should be viewed in relation to the fact that the population was ageing and was probably frequently not exposed to physical exercise to a similar extent in the latter part of the survey compared with the earlier part. It could also be argued that the coronary artery disease progressed, including new stenoses and the occlusion of grafts. Both the development of postoperative angina pectoris and the progression of atherosclerosis have been shown to accelerate slowly with time [12,13] and previous experience indicates that deterioration occurs, with 40% of patients reporting symptoms of chest pain 5 years after the operation [14].

We did not find any strong preoperative predictor of chest pain after 15 years, although higher age and longer duration of symptoms pointed in this direction. Previous reports have indicated that obesity and diabetes are associated with chest pain 10 years after surgery [15].

After an initial improvement following CABG, symptoms of dyspnoea increased more markedly over time. This is not surprising. The mean age of the patients 15 years after surgery was just below 80 years. In the previous studies with a shorter follow-up, it was reported that 33% of patients had symptoms of dyspnoea 1 year after surgery [16]. Most probably, a relatively high percentage of patients with dyspnoea have symptoms for reasons other than heart failure. The correlation between symptoms of dyspnoea and heart disease was never evaluated and might be very difficult to address. In terms of dyspnoea, the factors associated with these symptoms 15 years later could be defined as follows:

(1) Increasing age is associated with deterioration in myocardial function and also pulmonary function. The increasing frequency of dyspnoea does not therefore need to be explained by a recurrence of myocardial ischaemia.
(2) The need for inotropic drugs at the time of surgery indicates a compromised myocardial function at that time. It is not unlikely that many of these patients developed chronic heart failure over time, resulting in symptoms of dyspnoea 15 years later.
(3) A history of diabetes is associated with more extensive coronary artery disease [17] and the impairment of myocardial function [18]. Diabetes might therefore be expected to be associated with symptoms of dyspnoea 15 years later.
(4) Obesity has previously been shown to produce more symptoms of chest pain and dyspnoea in patients with coronary artery disease [19,20]. The mechanism behind this is not entirely clear, although the most plausible one is that obesity results in a higher work load, which may be followed by dyspnoea.

Even without arterial hypertension, obese subjects have increased levels of oxygen consumption, as well as increased pressure in the pulmonary artery, atria and at end diastole in the left ventricle [21]. Furthermore, the maintenance of normal ventricular performance in obese individuals is associated with the use of Starling reserve due to dilatation of the left ventricular [22]. These mechanisms may explain at least part of the association between obesity and dyspnoea.

5. Limitations

1. The response rate during various parts of the survey varied between 61% and 78% of those alive at the different time points, respectively, and only 354 patients responded to the inquiry on all four occasions.
2. The number of tests that were performed could lead to false significances by chance. However, we do not regard this as a major problem in the present study. Even if we applied the Bonferroni method to all the tests performed.
in Tables 2–5 and 7, the vast majority of significances would remain. Furthermore, there is a clear consistency between most of the variables studied, that is, a considerable improvement from preoperative variables at 5, 10 and 15 years after the operation, as well as a slight deterioration from 5 years after the operation.

3. The study is greatly affected by survival bias since more than half (55%) had died after 15 years.

6. Conclusion

Relief from chest pain and breathlessness achieved by CABG persists for a long time following surgery, but over time the symptoms slowly tend to re-appear, although to a modest degree. About half the surviving patients report symptoms of chest pain 15 years after CABG and three-quarters have some form of dyspnoea. Even though no obvious predictors of chest pain were found, age, the use of inotropic drugs, diabetes and obesity at the time of surgery were associated with dyspnoea 15 years later.

References


