Patient-related outcomes five years after coronary artery bypass graft surgery

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Summary

For five years, we prospectively studied 353 consecutive patients undergoing first-time coronary artery bypass graft surgery (CABG) for stable angina in the North of England. Angina was present before surgery in nearly all patients, in 20% 3 months after surgery, and in 48% after 60 months. The Nottingham Health Profile, showed a significant improvement in perceived health status (PHS) 12 and 60 months after surgery compared with preoperation. However, PHS at 60 months was worse than at 12 months in the dimensions ‘pain’ and ‘physical mobility’ in part 1, and in ‘looking after the home’ and ‘taking holidays’ in part 2. Employment rates were 36%, 34% and 21%, before, and 12 and 60 months after surgery, respectively. Working at 12 and 60 months was associated with age below retirement age, work preoperation and absence of angina, and at 12 months also with male gender and waiting time <6 months. This study describes everyday clinical practice. The significant improvement in angina symptoms and PHS after CABG persists for at least 5 years. However, only one third of patients in this geographical area return to work, and this is not solely dependent on clinical symptoms.

Introduction

Coronary artery bypass graft surgery is an effective treatment for patients with symptomatic coronary artery disease and in a subgroup, improves survival.\(^1\) However, it does not cure the underlying disease, and analyses of outcome are important to define the long-term efficacy of coronary artery surgery. Reports of outcome may be restricted to major cardiac events,\(^2,3\) to selected patients recruited to a clinical trial,\(^4–6\) or to patients treated within different health care systems. It is only from the study of unselected patients managed within our own individual health-care systems that we are able to define the efficacy of the surgical treatment we offer to our patients.

We have prospectively studied the outcome of 353 consecutive patients undergoing elective first-time coronary artery bypass graft surgery at the Freeman Hospital in North East England, and in this paper we report the prevalence of angina symptoms, perceived health status and employment status in patients 5 years after surgery.

Methods

Patients

The study population has been described before.\(^7,8\) Briefly, during the period 25 October 1988 to 4 December 1989, 367 consecutive patients were admitted for elective, first-time coronary artery bypass graft surgery to the Freeman Hospital. Coronary artery bypass graft surgery was performed for chronic stable angina or after unstable angina had settled. Fourteen patients were excluded. Eight lived outside the former Northern region, three had simultaneous valve surgery performed, and three refused to participate. Thus, 353 patients (297 male, 56 female)
consented and were recruited to this prospective study. The protocol for the study to 5 years was approved by the Newcastle Joint Ethics Committee.

**Procedures**

Patients were seen on the ward immediately before surgery, and 3, 6, 12 and 60 months after surgery. After surgery, the majority of patients were seen in a morning research clinic, but those unable to attend were either visited at home or asked to complete questionnaires at home.

Patients were asked about symptoms of angina. These were either typical symptoms or, if symptoms were atypical, the same as those experienced preoperatively. The severity of angina was classified using the Canadian Cardiovascular Society functional classification. Employment status and reasons why abnormalities seen during left ventriculography in the 30-degree right anterior oblique projection.

**Statistics**

Data manipulation and analyses used two statistical packages, Statview (Abacus Concepts) and STATA 3.1 (STATA Corporation). Continuous variables were described as mean (standard deviation) or median (25th to 75th percentiles) as appropriate and categorical variables as number (%). Survival was calculated using life-table methods. The Wilcoxon signed rank test was used to compare weighted scores for each dimension within part 1 of the NHP between different time intervals before and after surgery. McNemar’s test was used to compare groups in part 2 of the NHP and to compare differences in the number of patients employed and not employed between different time intervals before and after surgery. Waiting time for coronary artery bypass graft surgery was highly skewed, and differences in waiting time between patients employed/not employed at different time intervals after surgery were analysed using the Mann-Whitney U test. Where odds ratios (OR) are calculated, 95% confidence intervals (CI) are given. Potential covariates for working 12 and 60 months after surgery were examined using univariate logistic regression analysis. A forward stepwise regression analysis evaluated independent covariates for working at 12 and 60 months. Alpha <0.05 was considered significant.

**Results**

**Patient characteristics preoperation and operation details**

The clinical and angiographic characteristics of the 353 patients studied are summarized in Table 1. Two
Outcome 5 years after CABG

Table 1  Clinical characteristics and severity of coronary artery disease prior to coronary artery bypass graft surgery, and operation details

<table>
<thead>
<tr>
<th>Clinical characteristics</th>
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<tbody>
<tr>
<td>Male</td>
<td>297 (84%)</td>
</tr>
<tr>
<td>Mean (standard deviation) age</td>
<td>57.2 (7.3) years</td>
</tr>
<tr>
<td>Hypertension</td>
<td>133 (38%)</td>
</tr>
<tr>
<td>Diabetes</td>
<td>22 (6%)</td>
</tr>
<tr>
<td>History of hypercholesterolaemia</td>
<td>121 (35%)</td>
</tr>
<tr>
<td>Obesity (BMI $&gt;25$ kg/m$^2$)</td>
<td>214 (61%)</td>
</tr>
<tr>
<td>Never smoked</td>
<td>57 (16%)</td>
</tr>
<tr>
<td>Ex cigarette smoker</td>
<td>278 (80%)</td>
</tr>
<tr>
<td>Smoker at operation</td>
<td>11 (3%)</td>
</tr>
<tr>
<td>History of stroke/TIA</td>
<td>18 (5%)</td>
</tr>
<tr>
<td>History of claudication</td>
<td>58 (17%)</td>
</tr>
<tr>
<td>Previous myocardial infarction</td>
<td>215 (61%)</td>
</tr>
<tr>
<td>History of heart failure</td>
<td>19 (5%)</td>
</tr>
<tr>
<td>Renal disease (dialysis or transplant)</td>
<td>4 (1%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Severity of coronary artery disease*</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Single-vessel disease</td>
<td>68 (20%)</td>
</tr>
<tr>
<td>Two-vessel disease</td>
<td>138 (40%)</td>
</tr>
<tr>
<td>Three-vessel disease</td>
<td>94 (27%)</td>
</tr>
<tr>
<td>Left main-stem disease</td>
<td>45 (13%)</td>
</tr>
<tr>
<td>Normal LV</td>
<td>141 (41%)</td>
</tr>
<tr>
<td>Only hypokinetic LV segment</td>
<td>101 (29%)</td>
</tr>
<tr>
<td>Akinetic or dyskinetic LV segment</td>
<td>101 (29%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Operation details</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean (SD) number of graft conduits</td>
<td>2.74 (0.77)</td>
</tr>
<tr>
<td>Mean (SD) number of distal anastomoses</td>
<td>3.6 (1.20)</td>
</tr>
</tbody>
</table>

| Patients with vein graft | 332 (94%) |
| Patients with LIMA      | 266 (75%) |
| Patients with RIMA      | 46 (13%) |

BMI, body mass index; TIA, transient ischaemic attack; LV, left ventricle; LIMA, left internal mammary artery; RIMA, right internal mammary artery. * See text for details.

hundred and ninety-seven patients were male, 56 female. Mean (SD) age at the time of surgery was 57.2 (7.3) years. Hypertension was present in 38%, more than 60% had a history of preoperative myocardial infarction and 5% a history of heart failure.

More than one quarter had three-vessel disease and 13% had left main-stem disease. Left ventricular function was normal in 41% patients, 29% patients had only hypokinetic segments, while in 29% akinetic or dyskinetic segments were also present. A left internal mammary artery conduit was used in 75% of patients, and in only 6% patients were internal mammary artery grafts the only conduits used.

### Outcomes

Survival outcome is known for all patients. Forty-one patients died and three patients had second-time cardiac surgery within 5 years of coronary artery bypass graft surgery. Actuarial survival without further cardiac surgery was 87%. Questionnaires were completed by 307 (90%) survivors at 1 year after CABG surgery (mean 13.8 months, SD 2.0) and by 291 (94%) survivors at 5 years (mean 59.1 months, SD 1.4).

Thirty-one (11%) patients 5 years after surgery could recall having attended a cardiac rehabilitation programme, 29 (10%) after surgery and two (1%) before surgery.

### Angina

The prevalence of angina before surgery, and 3, 6, 12 and 60 months after surgery is presented in Figure 1. Before surgery, nearly all patients had angina. After surgery, the prevalence of angina fell markedly and at 3 months only 20% had angina. Thereafter, there was a steady rise in angina prevalence, reaching 48% at 60 months (Figure 1). The proportion of patients with angina with severe symptoms (grade 3 and grade 4) was greatest before surgery (74%). Three, 6, 12 and 60 months after surgery, 45%, 29%, 42% and 35% patients with angina had severe symptoms, respectively (Figure 1).

### Perceived health status

Compared with preoperation, there was a significant improvement in perceived health status 1 year after surgery within all dimensions of part 1 of the NH (all $p<0.001$) (Table 2). After 1 year, perceived health status deteriorated within some dimensions and at 5 years was worse within the dimensions of pain ($p<0.001$) and physical mobility ($p<0.01$) (Table 2). One year following surgery, patients had fewer problems within all seven areas of daily living in part 2 of the NH compared with before surgery (all $p<0.001$) (Figure 2). Five years after surgery, fewer patients had problems with their job of work compared with 1 year after surgery ($p<0.01$), but more patients reported problems looking after the home and in their ability to take holidays (both $p<0.05$) (Figure 2).

### Perceived health status and angina

Within the five dimensions (energy, pain, emotional reactions, sleep and physical mobility) of part 1, patients with more severe angina had a worse perceived health status than those with no or milder angina (Figure 3). This trend was seen both before and after surgery. However, the difference in perceived health status in patients with more severe angina compared to those with no or only mild angina tended to be greater after surgery than before (Figure 3) and after surgery, the perceived health status of patients without angina or with very mild angina was similar to that of controls (Figure 3).
There was a similar trend for the activities of daily living in part 2 of the NHP with patients with more severe angina reporting more problems within each area of daily living (Figure 4).

**Employment status**

Figure 5 shows the number of patients working and not working before and at time intervals after coronary artery bypass graft surgery. Three months after surgery, there was a significant fall in the proportion of patients employed compared with preoperation (44 (14%) vs. 123 (36%), \( p < 0.001; \text{OR} 0.13 \ (95\% \ CI 0.06–0.25) \)). Thereafter there was a significant increase (44 (14%) at 3 months vs. 98 (32%) at 6 months, \( p < 0.001; \text{OR} 7.00 \ (95\% \ CI 3.46–16.00) \)). Six and 12 months after surgery, there was no significant difference in the proportion of patients employed, but there was a significant fall by 60 months (104 (34%) at 12 months vs. 60 (21%) at 60 months, \( p < 0.001; \text{OR} 0.15 \ (95\% \ CI 0.06–0.34) \)).

**Reasons for not working**

Before surgery, approximately 40% of the population were not working because of health problems, rising to approximately 50% at 3 months (Figure 5). However, thereafter the proportion of patients not working due to poor health fell to approximately 30% and was fairly constant, and 60 months after surgery the fall in the number of patients working is mirrored by an increase in the proportion of patients not working for other reasons, mainly because patients had reached retirement age (Figure 5).

Of those patients who were employed 5 years after surgery, more were in non-manual jobs than in manual jobs (44 (73%) vs. 16 (27%)), and 17 (28%) were self-employed. Nineteen (32% of those working) patients had changed their jobs post operation. Six (32%) were doing lighter work, but the same hours, four (21%) were working shorter hours and four (21%) were doing both. Forty-two (71%) patients said they enjoyed their work ‘most of the time’, 11 (19%) ‘some of the time’ and six (10%) ‘none of the time’.

Patients who were working before surgery were more likely to do so after surgery. Eighty-one (74%) patients working before surgery were working 12 months after surgery compared with only 22 (12%) of those not working before surgery. Similarly, 44 (42%) patients who were working before surgery were also working 60 months after surgery, but only 15 (8%) patients who had not been working before surgery were doing so.

**Waiting time for surgery**

The median (interquartile range) waiting time for surgery was 7.23 (9.02) months. The median waiting
time of patients not working was longer than those
working before (8.4 vs. 4.4, \(p<0.001\), and 3 (8.1
vs. 4.3, \(p<0.05\), 6 (8.2 vs. 5.5, \(p<0.05\), and 12
(8.3 vs. 5.0, \(p<0.01\) months after surgery. Sixty
months after surgery, this difference was no longer
significant (7.7 vs. 4.9).

Employment and angina

One year after surgery, 20 (19%) employed patients
had angina: two with grade 1 angina, 14 with grade
2 and four with grade 3. Similarly, 5 years after
surgery, 12 (20%) employed patients had angina; six
with grade 1 angina, two with grade 2, two with
grade 3, and two with grade 4.

Covariates for working

The following were considered as potential covariates
for employment at 12 and 60 months; age below
retirement age at 12 and 60 months, respectively,
gender, working preoperation, angina symptoms at
12 and 60 months respectively, and waiting time for
surgery <6 months.

Twelve months after surgery, age below retirement
age (41% vs. 10%, OR 6.28 (95% CI 2.60–15.16),
\(p<0.001\), male gender (39% vs. 8%, OR 7.74 (95%
CI 2.32–25.75), \(p<0.01\), working preoperation
(74% vs. 12%, OR 22.09 (95% CI 11.91–40.99),
\(p<0.001\), freedom from angina (41% vs. 22%, OR
2.49 (95% CI 1.41–4.40), \(p<0.01\) and waiting time
<6 months (43% vs. 28%, OR 1.87 (95% CI
1.15–3.02), \(p<0.05\) were significantly associated
with working in univariate analysis. In forward
stepwise logistic regression analysis, male gender
\(p<0.05\), working preoperation \(p<0.001\) and
freedom from angina \(p<0.001\) remained as inde-
pendent predictors.

Sixty months after surgery, age below retirement
age (30% vs. 5%, OR 7.63 (95% CI 3.16–18.44),
\(p<0.001\), working preoperation (42% vs. 8%, OR
7.71 (95% CI 4.01–14.85), \(p<0.001\) and freedom
from angina at 60 months (32% vs. 9%, OR 4.98
(95% CI 2.51–9.87), \(p<0.001\) were significantly
associated with working in univariate analysis, and
in forward stepwise logistic regression analysis
remained as independent predictors (all \(p<0.001\)).

Discussion

In this paper we report angina symptoms, perceived
health status and employment status in an unselected
group of patients up to 5 years after elective, first-
time coronary artery bypass graft (CABG) surgery.
CABG surgery is most frequently performed to relieve
angina. Clinical trials of medical and surgical man-
agement of patients with coronary artery disease

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Table 2

<table>
<thead>
<tr>
<th>Time</th>
<th>Energy</th>
<th>Pain</th>
<th>Emotional reactions</th>
<th>Sleep</th>
<th>Social isolation</th>
<th>Physical mobility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preoperative</td>
<td>60.8 (24–100)</td>
<td>17.05 (5.83–38.7)</td>
<td>10.07 (0–38.26)</td>
<td>0 (0–24)</td>
<td>0 (0–6.3)</td>
<td>11.54 (0–31.29)</td>
</tr>
<tr>
<td>12 months after CABG</td>
<td>0 (0–24)</td>
<td>0 (0–6.3)</td>
<td>0 (0–24)</td>
<td>0 (0–24)</td>
<td>0 (0–6.3)</td>
<td>11.54 (0–31.29)</td>
</tr>
<tr>
<td>60 months after CABG</td>
<td>0 (0–24)</td>
<td>0 (0–6.3)</td>
<td>0 (0–24)</td>
<td>0 (0–24)</td>
<td>0 (0–6.3)</td>
<td>11.54 (0–31.29)</td>
</tr>
</tbody>
</table>
Figure 2. Proportion of patients reporting problems with activities of daily living in part 2 of the NHP before, and 12 and 60 months after coronary artery bypass graft surgery.

Figure 3. Median NHP scores within part 1, stratified by prevalence and severity of angina before and 60 months after coronary artery bypass graft surgery (EN, energy; ER, emotional reactions; SL, sleep; SI, social isolation; PM, physical mobility).

have shown that surgery is superior to medical treatment for at least 5 years.\textsuperscript{6,12,13}

Reports of freedom from angina 5 years after surgery vary widely, ranging from 46\% to 83\%.\textsuperscript{5,6,14–19} These differences probably reflect differences in definition, but also the different recruitment criteria of studies and possibly the rate of reintervention within the studies. In the present study of unselected patients, 52\% were free of angina 5 years after surgery and is comparable to others.\textsuperscript{6,18} However, the proportion with severe angina (Canadian Cardiovascular Class III and IV) may be higher in
Outcome 5 years after CABG

Figure 4. Proportion of patients reporting problems with activities of daily living in part 2 of the NHP, stratified by prevalence and severity of angina before and 60 months after coronary artery bypass graft surgery.

Figure 5. Proportion of survivors working and not working before, and 3, 6, 12 and 60 months after coronary artery bypass graft surgery. The number of patients is shown at each time interval.
our patients than in other populations (35% vs.
25%).5

There is increasing emphasis on measures of
outcome which examine the patients perception
of their own illness and outcome from treatment.
Psychological well-being may be evaluated using
questionnaires,20–24 but others have relied on more
indirect measures such as relief from angina and
exercise abilities, and assume that these translate
into improved quality of life.6,13

Health status improves following coronary artery
surgery. This improvement has been shown within
two20 and three20,22 months of surgery, and was also
seen one20,21 and two22 and three24 years after
surgery. However, there was less benefit for sexual
relations one,21 two22 and three24 years after surgery.
Five years after surgery, patients generally reported
some degree of improvement compared to preopera-
tion, with men fairing better than women, but
detailed questionnaires were not used and patients
were asked to evaluate their health status retrospect-
ively as ‘greatly improved’, ‘slightly improved’ or ‘no
better or worse’.25 A more favourable perceived
health status was also reported 5 years after surgery
in patients who had participated in a cardiac rehabil-
itation programme compared to those who had not,
although the programme had a limited influence on
return to work.26 In our study, we have assessed
perceived health status prospectively up to 5 years
after surgery using the NHP. This is a well-validated
questionnaire and has been used in other cardiac
studies.20,22,23,26,29 Compared with preoperation,
there was a marked improvement in perceived health
status one year after surgery in all areas evaluated
by the NHP. Within some areas, perceived health
status was worse 5 years after surgery than at 1 year,
although it was still better than before surgery. Job
of work was an exception, and fewer patients
reported problems with their job of work at 5 years
compared to 1 year. This may be partly due to the
increasing number of patients who are retired, but
patients with problems may have given up work
months or years earlier, and no longer perceive that
they have a current problem with their job of work.
Too few of our patients had participated in a cardiac
rehabilitation programme for the impact of this on
perceived health status to be defined.

Thirty-six percent of our patients were working
before surgery. Return to work after CABG has been
reported more frequently in patients who are free of
angina,24 and our patients were also more likely to
be working both 1 and 5 years after surgery if they
were free of angina. However, the highest proportion
of survivors working after surgery was at 1 year, but
even then there were only 34% working, even
though nearly 70% were free of angina. Levels of
return to work have varied widely between countries
from below 50% to more than 90%,30 and medical
parameters cannot explain these discrepancies. Thus
its value as a measure of a successful long-term
outcome from surgery is impaired by the impact of
non-medical parameters such as a prolonged waiting
time for surgery,30,31 the increasing age of the popu-
lation30,31 and the economic environment. In our study,
beyond 6 months after surgery, fewer patients were
not working due to their health than for other
reasons. It is inevitable that more patients will have
retired as the time from surgery extends. Patients
who have time away from work and who are close
to retirement age may also elect to retire just below
the normal retirement age. However, the importance
of the economic environment as a confounding
variable must not be underestimated. The present
study was conducted at a time of high unemployment
in the North of England, and failure to return to
work may not indicate an unsuccessful outcome
from surgery, but rather the prevailing high employ-
ment in the region.

Patients who wish to work after coronary artery
surgery are more likely to do so than those who do
not,32 and is another indication that factors other
than functional status are important determinants
of return to work. We did not ask our patients directly
if they wished to work after surgery, but patients
who were working at 5 years were asked if they
enjoyed their jobs. The majority did so at least part
of the time, and this indirectly suggests that patients
who continue to work after surgery wish to do so.

The nature of work being undertaken also predicts
return to work. Patients who return to work after
surgery are more likely to be in non-manual jobs33
and they may also change to less manual work,20,21
or reduce the number of hours they work.20 The
majority of patients in our study who were working
at 5 years were in non-manual jobs, and just under
one quarter were doing lighter work, shorter hours
or both than before surgery. Self-employment and
professional and executive employment is predictive
of return to work.33 Just over a quarter of our patients
were self-employed and this high prevalence is likely
to be multifactorial. Patients who are self-employed
may have a greater incentive to return to work, both
financially and for job satisfaction, and they may be
more readily able to adapt their own working lives
to their functional status.

In our study, a shorter waiting time and working
before surgery both predicted a return to work after
surgery. However, a shorter waiting time was not
independently associated with return to work, and
patients who were still working before surgery may
have been given priority on the waiting list. However,
the situation may be more complex. Patients with
manual jobs are less likely to return to work and
thus patients who were working may be in a higher
social class. The inverse care law reported for revascularization may also be seen in waiting times for surgery.

In conclusion, coronary artery bypass graft surgery is a valuable tool for treating patients with symptomatic coronary artery disease. Angina symptoms are palliated, and patients report that they feel their health is better. Return to work as an indicator of a successful surgical programme may be less pertinent. Undoubtedly patients who have severe restrictions to their functional status are unlikely to work, but it is too simplistic to conclude that functional status alone determines return to work, and there are a number of non-medical parameters to be considered. Promoting return to work after surgery cannot be simply based on improving functional status without addressing these other factors.

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References


