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Authors

OLDENBURG, B
PIERCE, J
SICREE, R
et al.

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CORONARY RISK FACTOR OUTCOMES FOLLOWING CORONARY ARTERY BYPASS SURGERY

B. OLDENBURG

Lecturer, Department of Public Health, University of Sydney, NSW

R. SICREE

Formerly Master of Public Health student, Department of Public Health, University of Sydney, NSW

J. PIERCE

Chief Epidemiologist, Office of Smoking and Health, Washington, D.C., USA

D. ROSS

Cardiothoracic Surgeon, Department of Cardiothoracic Surgery, Royal North Shore Hospital, NSW

Abstract:

The coronary risk factor status of patients prior to and following coronary artery bypass surgery (CABG) has been poorly investigated. Two consecutive series of CABG patients were surveyed following CABG. One hundred and thirty patients were assessed immediately following CABG and 530 patients were assessed 12-30 months following CABG. For the long-term post-CABG group, over 80% of those who had ever smoked had ceased. Sixty-four per cent of these males and 50% of females were classified as being overweight. Twenty-five per cent of males and 34% of females reportedly had high serum cholesterol (i.e. ≥ 6.5 mmol/L). Comparing these CABG data with age-adjusted National Heart Foundation Risk Factor Prevalence Survey data, there was a higher prevalence of ex-smokers, overweight, hypertension, and elevated cholesterol. It was concluded that on most coronary risk factors, except for smoking, these CABG patients had a worse profile than the general Australian community. This problem warrants further research and the development of appropriate treatment programs. (Aust NZ J Med 1989; 19: 234-240.)

Key words: Coronary artery bypass surgery, risk factors.

INTRODUCTION

Coronary artery bypass surgery (CABG) is a major procedure, generally performed on individuals with significant coronary heart disease. Currently, CABG has come to be one of the most common major surgical procedures to be performed in Australia.¹ In the United States CABG is the second most common form of major elective surgery, after cholecystectomy, at a cost of up to 1% of the national spending on health.² In 1982, there were 377 operations/million population in Australia compared with 730 in the United States and 120 in the United Kingdom.³ There is agreement that CABG promotes relief of angina symptoms in patients in whom intensive medical therapy has failed and that it improves prognosis in those with

left main coronary artery stenosis and probably also, those with stenosis of all three main coronary vessels.⁴⁻⁷ This means however, that for the majority of patients undergoing CABG, i.e. those with other types of disease, the primary purpose of the procedure is to relieve angina and thereby, improve quality of life.⁸

While much research has addressed the impact of CABG on physical outcomes, the impact on quality of life outcomes and risk factor status is equally important. The impact of CABG on quality of life has been the subject of a recent extensive review.³ The risk factor status of subjects prior to, and following CABG however, has been poorly investigated to date. This is rather surprising considering that the patency of saphenous vein

bypass grafts declines significantly in the months and years following CABG. Ongoing graft atherosclerosis following CABG is very likely to be associated, at least in part, with elevated plasma lipid levels and reduced high-density lipoprotein cholesterol levels;^{9,10} and the effects of hypertension, cigarette smoking and diabetes are possibly also significant, but less clear-cut.

In order to develop appropriate guidelines for pre- and post-CABG risk factor modification programs there is an obvious and urgent need to understand better the coronary risk factor profile of these patients. Leaman¹¹ has already shown, for example, plasma lipid and blood pressure levels to be higher amongst surgical patients than the Dutch population in general, and past smoking rates to be similar. Patients of the European Coronary Surgery Study,¹² had high levels of hypercholesterolemia, but not apparently of other risk factors. There is no reason to believe that there is any great improvement in patients' risk factor profiles following CABG, except perhaps, hypertension. In fact, it seems likely that without specifically intervening, most improvement in risk factor status following the diagnosis of CHD probably occurs prior to CABG. In Leaman's longitudinal study,¹¹ there was no significant reduction in smoking level post-surgery; however, 50% of smokers had already ceased prior to surgery. There was however, a significant reduction in hypertension prevalence, suggesting improved control of this. The prevalence of hypercholesterolemia (i.e. serum concentration greater than 250 mg/ml) actually increased following surgery. In another study of smoking behaviour,¹³ 60% of smokers ceased by the time of followup. In some Australian data on risk factor patterns following CABG, Simons and Simons¹⁴ have recently reported the followup of a small Australian cohort of 103 patients six-12 months following CABG. They reported that approximately two of every three subjects manifested hypercholesterolemia, one in four subjects manifested hypertension and one in three subjects was overweight; and one in 20 subjects reported themselves to be current smokers.

The study reported here was carried out in order to investigate:

1. the demographic, employment and self-reported risk factor status characteristics of patients with CHD requiring CABG. Two series of patients, who had undergone CABG surgery (either recently or 12 to 30 months previously), were surveyed and compared with a group of community controls;
2. the extent to which self-reported risk factor

levels, and attitudes to modifying cardiac risk factors change subsequent to CABG. This was done by comparing an immediate post-CABG series of patients with a long-term post-CABG group of patients.

PATIENTS AND METHODS

Patients

The study was conducted at Royal North Shore Hospital, an 800 bed teaching Hospital in Sydney, Australia between July, 1980 and June, 1983. A consecutive series of 694 outpatients (the long term post-CABG group), who underwent CABG surgery at Royal North Shore Hospital, between the years 1980 and 1981, were surveyed with a mailout questionnaire 12 to 30 months following surgery in order to assess their lifestyle at that time. A further consecutive series of patients, who were operated on in 1982-83, was surveyed in hospital immediately following CABG (the immediate post-CABG group) in order to assess their lifestyle prior to hospitalisation for surgery. There was a total of 140 patients surveyed in this series.

For the long-term post-CABG group, there was followup information available on 566 subjects (a response rate of 81.6%) and information was complete on 530 subjects. For the immediate post-CABG group the response rate (n = 130) was 93%. The difference in response rates notwithstanding, comparison of the immediate and long-term post-CABG groups indicated no significant differences for age, sex, medical variables or measures of pre-operative cardiac history.

Questionnaire Design, Scoring and Analysis

The self-report questionnaire assessed the following major areas of lifestyle, health and medical treatment at the time of questionnaire administration: demographic details; coronary heart disease history; risk factor status (extent of family history, cigarette consumption, weight and height, blood pressure and antihypertensive medication, serum cholesterol, exercise patterns and Type-A behaviour); risk factor concern and monitoring behaviour; some psychosocial measures; employment status and post-operative symptoms.* Questions about self-reported cardiac risk factor levels were made comparable, where possible, to those used in the most recently conducted, at that time, nationwide survey of coronary risk factors in the Australian community, the 1980 National Heart Foundation of Australia Risk Factor Prevalence Study.¹⁵ All analyses were carried out using the Statistical Package for the Social Sciences.¹⁶

*A copy of the questionnaire is available from the first author (BO).

TABLE 1
Age and Gender Distribution of CABG Survey Populations (n = 649)^a Compared to Australian CHD Mortality and CHD-Specific Admission to NSW Public Hospitals

Age-group (at time of operation)	CABG subjects			ABS ^b data	NSW hospital data ^c
	Male	Female	Male/female CABG ratio	Male/female CHD mortality ratio	Male/female CHD admission ratio
20-39	18	2	9.0	4.3	4.6
40-49	81	10	8.1	3.9	3.5
50-59	240	35	6.9	4.0	3.0
60-69	179	41	4.4	2.4	2.3
70-79	29	14	2.1	1.5	1.1
80+	0	0	—	—	—
	547	102	5.4		

^aAge at operation was not available for seven male and four male female CABG subjects.

^bAustralian Bureau of Statistics (1981).

^cThe CHD-specific admission ratio was taken from NSW statistics for 1977 on Principal Diagnosis at hospitalisation. Age stratification was for subjects <35, 35-44, 45-54, 55-64 and 65+.

RESULTS

Characteristics of Patients who Received CABG Surgery

For the patients surveyed, the mean age was 57.3 years (SD 8.5) and 84% were males. Table 1 compares the age-specific gender ratio of the study population compared to 1981 Australian Bureau of Statistics CHD mortality figures¹⁷ and 1977 NSW Public Hospital CHD admission figures.¹⁸ For each age group, the gender ratio for CABG subjects was approximately twice that in the CHD population in the general community.

Coronary Risk Factor Status of Long-Term Post-CABG Patients

Long-term post-CABG respondents' levels of several major cardiac risk factors, including

cigarette use, obesity, presence of hypertension and hypercholesterolemia, and exercise frequency are shown in Table 2. These values are compared with the results of the National Heart Foundation of Australia 1980 Risk Factor Prevalence Study. To control for age the NHF data used were those from males over 45 years and females over 50 years of age.

Smoking

The higher percentage of long-term post-CABG males than females who had ever smoked was also reflected in daily cigarette consumption. Whereas male smokers previously, had consumed a mean of 24 cigarettes per day (SD 15), female smokers had consumed a mean of 16 cigarettes per day (SD 11), $p < .001$. There was a higher level of 'ever having

TABLE 2
Levels of Selected Cardiac Risk Factors Amongst Long-Term CABG Subjects Compared to National Heart Foundation Risk Factor Prevalence Survey subjects

Risk factor variable	Males		Females	
	CABG (n = 441) n (%)	NHF (n = 1328) n (%)	CABG (n = 89) n (%)	NHF (n = 1040) n (%)
Ever smoked	329 (77%)	957 (72%)	51 (57%) +	416 (40%)
Ex-smokers (of ever smoked)	281 (85%) +	474 (50%)	75 (83%) +	166 (40%)
BMI (kg/m ²) (u ± SEM)	26.7 ± 0.10 +	26 ± 0.08	25.4 ± 0.4	25 ± 0.1
Overweight ^a	282 (64%) +	643 (48%)	45 (50%)	485 (47%)
Hypertensive ^b	207 (47%) +	466 (35%)	59 (66%) +	372 (36%)
High cholesterol ^c	110 (25%)	307 (23%)	30 (34%)	403 (39%)
High exercise frequency	225 (51%) +	374 (28%)	31 (35%) +	178 (17%)

* $p < .05$; + $p < .01$

^aNHF and CABG subjects were considered overweight if their BMI was ≥ 26 (males) or ≥ 25 (females).

^bNHF and CABG subjects were considered to be hypertensive if they were on medication or had a diastolic blood pressure ≥ 95 mmHg.

^cFor NHF subjects hypercholesterolemia was based on a level > 6.5 mmol/L. For CABG subjects it represented an expected high or borderline level.

smoked' amongst these CABG subjects compared with NHF 'controls'. For males this difference was greatest for those under 50 years of age. Whereas only 24% male CABG subjects less than 50 years had never smoked, 36% of NHF controls had never smoked. Conversely, these data indicated a much higher smoking cessation rate amongst the long-term post-CABG study population (over 80%, for males and females) compared to the NHF group (40 and 50%, respectively) ($p < .001$).

High Blood Pressure and its Treatment

The methods used to classify CABG patients and NHF subjects as 'hypertensive' were different. The NHF study classified subjects as hypertensive if they were on anti-hypertensive medication, or had a measured diastolic blood pressure ≥ 95 mmHg, while CABG subjects were considered hypertensive if on medication, or, if they reported their blood pressure to be elevated i.e. ≥ 95 mmHg. The difference in the classification procedures used notwithstanding, these data suggest that hypertension was more common for both CABG males and females compared to the NHF group ($p < .01$). The relative risk for hypertension amongst CABG subjects was greater at younger ages. For male CABG subjects compared to NHF male subjects, hypertension was three times more prevalent at age 30-39 years (i.e. 45% compared to 14%), two times more prevalent at age 40-49 years, but there was no difference for subjects over 50 years. Even allowing for some differences in the classification procedures used in this and the National Heart Foundation studies, recognition and treatment of high blood pressure appears to be much better amongst the CABG subjects; over 95% of those classified as hypertensive were on treatment of some kind.

Obesity and Cholesterol

For males, but not females, there was a significant difference in mean estimated BMI between the CABG and NHF groups. Male CABG subjects showed a higher mean estimated BMI ($p < .001$) and a greater percentage of this group (64%), compared to the NHF group (48%), were classified as being overweight ($p < .001$). The difference between male CABG and NHF subjects was more pronounced at younger age-groups. For male CABG subjects the prevalence of overweight for the 30-39 years and 40-49 years groups was 61% and 80%, respectively, and for the same NHF groups, 21% and 34%, respectively.

Over a quarter of the CABG sample (slightly more females (34%) than males (25%)) reported that they had a high cholesterol level. However, a high number of CABG respondents, 145 (22%)

admitted not knowing their cholesterol level even though in many cases, a level had been taken recently. A further 22 subjects provided no response to this question. As was the case for obesity, comparison of cholesterol with the NHF study population was less than satisfactory as the CABG population did not have measured cholesterol levels. However, research has shown that individuals in the community tend to underestimate cholesterol levels and weight. Given that cholesterol levels, in particular, were not strongly emphasised by physicians or surgeons in the late 1970s and early 1980s, it is very likely that the CABG group's perceptions of both cholesterol levels and weight were markedly underestimated. Thus, the differences between the surgery group and the community controls are probably much greater than those reported here.

Exercise

For both males and females, there were almost twice as many long-term CABG respondents as NHF subjects, who were exercising frequently ($p < .01$). Amongst both study groups, however, reflecting community prevalence data, males exercised more frequently than females.

Change in Risk Factor Status Following CABG Surgery (immediate vs long-term post-CABG groups)

Detailed information was collected on the risk factors of smoking and obesity allowing for a comparison to be made between the immediate- and long-term post-CABG series of patients. This comparison helps address the critical research and clinical question of the extent to which risk factor levels and attitudes to modifying cardiac risk factors change subsequent to CABG.

There was no significant difference in the number who had ever smoked in the two groups (77% and 75% respectively), but whereas almost all of those who had ever smoked in the immediate post-CABG group (97%), claimed to have ceased smoking at the time of CABG surgery, 15% of the 'ever smoked' group among the long-term responders, classified themselves as current smokers ($p < .01$).

Table 3 shows immediate- and long-term post-CABG male respondents' data pertaining to obesity and related lifestyle behaviours and attitudes. Significantly more of the immediate respondents (30%) reported having lost weight recently compared with the long-term subjects (20%), $p < .05$. Immediate post-CABG subjects, compared to the long-term group, also rated themselves to be more optimistic, both about being able to lose weight in the future (52% and 36% respectively,

TABLE 3
Differences Between Males Immediate Post-CABG and Long-Term Post-CABG^a on Measures of Weight and Related Lifestyle Behaviours

	Long-term (n = 441) post-CABG n (%)	Immediate (n = 113) post-CABG n (%)	
Body mass index (kg/m ²)	26.7 + 0.1	26.8 + 0.3	NS
Gained weight	166 (38%)	22 (20%)	+
Lost weight	88 (20%)	33 (30%)	*
Attempted weight change	217 (51%)	55 (51%)	NS
Rate future weight loss highly	157 (36%)	57 (52%)	+
Desired weight loss (kg)	3.9 + 0.2	5.1 + 0.5	*
3-monthly blood pressure checks	326 (76%)	57 (53%)	+
On anti-hypertensive medication	190 (47%)	33 (34%)	*
Don't know blood pressure/medication	51 (12%)	23 (21%)	*
Salt consumption index ^b	5.5 + 0.08	5.3 + 0.2	NS
Annual cholesterol check	131 (31%)	29 (27%)	NS
No previous cholesterol check	65 (15%)	19 (18%)	NS
Cholesterol elevated	83 (25%)	35 (39%)	*
Don't know cholesterol	94 (22%)	21 (19%)	NS
Fats consumption index ^c	9.7 + 0.1	8.9 + 0.3	*
Exercise frequency (high)	223 (51%)	39 (36%)	+
Exercise type (high)	178 (40%)	46 (40%)	NS

* $p < .05$; + $p < .01$.

^aThe small size of the female inpatient group (17 persons) made the detection of significant inpatient-outpatient differences most unlikely so they were excluded from this analysis.

^bA composite score derived from individual items assessing usage of salt in cooking and at the table. A higher score indicates lower consumption.

^cA composite score derived from individual items assessing frequency of consumption of meat, eggs, oil-fried foods, butter and margarine. A higher score indicates lower consumption.

$p < .01$), as well as, about the amount of weight they thought they were likely to lose (means, 5.1 kg and 3.9 kg respectively, $p < .05$).

DISCUSSION

In this study of 660 CABG patients many more males than females were operated on, reflecting, at least in part, the higher incidence of CHD among males. This gradient appears to lessen with increasing age, but nonetheless, at all ages, the male/female operation rate is considerably greater than that reflected in Australian CDH mortality,¹⁷ or NSW hospital CHD admission figures.¹⁸ Thus, either males with heart disease are more likely to have disease of a type which warrants coronary artery surgery, or there is a gender bias in the screening process for surgery.

Coronary Risk Factor Status in Long-Term CABG Patients

Smoking

Not surprisingly, a higher percentage of males than of females had ever smoked among the CABG survey group. Data on daily cigarette consumption also showed a significant difference between male and female smoking habits. For CABG females in all age categories, but not males, there was a higher proportion of current or ex-smokers than NHF 'controls'. When the male results were stratified by age however, there was a significant difference in

smoking rates between the NHF and CABG groups for those under 50 years of age. This result is not very surprising given the known association of smoking with CHD, and the weakening of this association for older persons. Most importantly, these data confirmed a much higher smoking cessation rate amongst the series of CABG subjects compared with community controls. This suggests that awareness of severe CHD is probably a strong factor motivating persons to discontinue smoking. The post-CABG quit rate detected in this study is approximately in the middle range of quit rates detected in those few studies that have examined smoking cessation in the CABG population. An analysis of factors associated with a failure to discontinue smoking following CABG surgery is discussed in another paper.¹⁹

High Blood Pressure and its Treatment

Drawing conclusions from the comparison between the CABG and NHF groups for these data needs to be done with some caution as the methods used to classify patients were different. This problem notwithstanding, it is likely that hypertension was more common for both CABG males and females compared to the NHF group. As with the other risk factors of smoking and obesity, the relative risk for hypertension amongst CABG subjects was greater at younger ages. Whereas amongst the NHF group, hypertension was equally prevalent among males

and females, for the CABG group, it was reportedly more common among females. The NHF Risk Factor Prevalence Survey data indicated that undiagnosed and/or untreated hypertension is a significant and serious problem in the Australian community; only about 50% of NHF subjects with hypertension were being treated. Recognition and treatment of high blood pressure appears to be much better amongst the CABG subjects. Of course, further research is required to ascertain whether this treatment is satisfactory.

Obesity and Cholesterol

For males, but not females there was a significant difference in mean BMI between CABG and NHF subjects. The CABG group showed a higher mean BMI and a greater percentage of this group, compared to the NHF group, were classified as being overweight. As with smoking and hypertension, this difference was more pronounced with younger age-groups.

A high number of CABG respondents admitted not knowing their cholesterol level or did not respond to this question. Thus, there appears to be, amongst subjects following CHD, a lack of awareness or concern (by patients themselves and/or health care providers) about control of cholesterol. It is not known whether health professionals' and the community's increased awareness of and concern about the importance of elevated cholesterol in the past few years has had any major impact on the CABG individual. As already previously mentioned, the figures reported in this study are very likely to underestimate greatly the extent of hypercholesterolemia in these CABG patients. Other studies, including an Australian study,¹⁴ have detected rates of hypercholesterolemia almost double those found in the current study.

Exercise

Notwithstanding the slightly different questions used in the NHF and CABG surveys to assess frequency of physical activity, the results suggest that the CABG group survey group exercised considerably more frequently than NHF controls. As the majority of the CABG group (80%) were surveyed 1-2 ½ years following surgery, such a result is suggestive of either a satisfactory result post-operatively with exercise tolerance improving, and/or of the CABG group being more aware of the possible value of exercise.

Change in Risk Factor Status Following CABG Surgery

Smoking

There was no method of directly validating subjects'

assessments of their smoking habits, and so it is possible that a proportion of the immediate post-CABG subjects, who classified themselves as 'ex-smokers', had only ceased for a very brief period, or had not, in fact, ceased at all. Rather, they may have given the response they felt was expected of them by their doctor. Conversely, recent research that has compared self-reported smoking behaviour against a physiological marker, such as saliva cotinine, has demonstrated the former to be much more accurate than previously believed.²⁰ Fifteen per cent of the long-term post-CABG ex-smokers continued and/or recommenced smoking in the months following CABG surgery, the latter group mainly being those, who only ceased smoking immediately prior to surgery. Such a finding is consistent with the finding in a number of recent studies that smoking 'recidivism' is most common among recent 'quitters'. These data suggest that cardiac surgeons' and other health care workers' efforts to control patients' smoking habits pre- and post-CABG are less than successful in the longer term.

Obesity and Related Lifestyle Behaviours

Significantly more of the immediate post-CABG group claimed to have lost weight, and significantly fewer, to have gained weight in the previous 12 months, compared to the long-term CABG group. The former group were significantly more likely to rate weight loss as very important and to estimate a higher weight loss as desirable. The increased awareness and management of blood pressure by the long-term CABG subjects, compared to the immediate post-CABG subjects, was also reflected in some dietary behaviours, such as a lower consumption of fatty foods and possibly also, lower levels of cholesterol. However, this group did not necessarily demonstrate increased awareness of all dietary measures, such as reduced salt consumption.

Conclusions

These study results need to be interpreted with some caution because of the self-report and cross-sectional nature of the data and the fact that the response rates were different between the two series. To date, there has been a paucity of risk factor research with CABG patients.

These study data indicate that on most coronary risk behaviours (except for smoking and perhaps also, physical inactivity) these two groups of CABG patients had a worse profile than the Australian community in general. Given the increasingly well established relationship between, at least, elevated blood lipids and decline in graft patency following CABG, it is striking that very little attention has

been directed to developing and evaluating appropriate coronary risk factor reduction interventions that can be used with the post-CABG patient. This is in stark contrast to the effort that has gone into such research with patients following myocardial infarction.²¹

These study data demonstrate that, far from 'automatically' modifying their lifestyle after coronary artery surgery, a sizeable proportion of these patients continued with those very coronary risk behaviours which contributed to the atherosclerotic process in the first place. Of even greater concern, though, these data show that, for some patients, there may even be a significant rate of 'recidivism' in smoking and weight gain in the years following CABG. It is not clear from these data, however, whether this phenomenon is similar to that evident in the resumption in smoking that occurs, for example, six-12 months following myocardial infarction,²² or whether it occurs as a result of a perception of 'invulnerability' that many patients have following CABG.

There is a need for further research into the coronary factor profiles of CABG patients, in particular, studies of a prospective kind, as well as, the evaluation of cost-effective educational and behavioural interventions that might impact on coronary risk behaviours. ■

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