Clin. Cardiol. 21, 913–916 (1998)

Characteristics of Patients Less than 45 Years of Age Compared with Older Patients Undergoing Coronary Artery Bypass Grafting

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Summary

Background: Coronary artery disease (CAD) was not recognized as common among young patients until the study by Yater in 1948. Subsequent studies further elucidated the nature of the disease, which had become more apparent in the younger groups.

Hypothesis: The study was undertaken to determine the prevalence of risk factors and severity of coronary disease among young patients aged ≤ 45 years undergoing coronary artery bypass grafting (CABG) compared with older patients.

Methods: In all, 112 young patients aged ≤ 45 years (Group 1) and 798 older patients aged > 45 years (Group 2) were analyzed for trends to hypertension, smoking, diabetes, family history of heart disease, hypercholesterolemia, obesity, and history of previous myocardial infarction (MI). The severity of disease was examined in terms of number of diseased vessels, vessel size, number of grafts performed, performance of endarterectomies, and left ventricular function.

Results: Group 1 had a higher incidence of positive family history (68.5 vs. 51.2%, $p < 0.05$), and lower incidences of hypertension (62.7 vs. 81.5%, $p < 0.05$), obesity (42.9 vs. 83.9%, $p < 0.05$), and history of previous MI (54.5 vs. 94.6%, $p < 0.05$). Group 2 had a higher incidence of left main disease (22.6 vs. 11.4%, $p < 0.05$). The distribution of the affected vessels of the young patients was most commonly the left anterior descending (90.4%) followed by the right coronary (79.8%) and circumflex arteries (69.2%). Group 2 had more grafts per patient (3.82 vs. 3.37, $p < 0.05$). The size of the diseased vessels measured intraoperatively was similar (1.56 vs. 1.58 mm, p = NS) in both groups. Endarterectomy was performed almost three times more often in Group 1 patients (8.2 vs. 3.0%, $p < 0.05$). Operative mortality was less in Group 1 mean (1.8 vs. 6.3%, $p < 0.05$). Group 2 had a greater mean left ventricular ejection fraction (53.8 vs. 49.7%, $p < 0.05$).

Conclusion: Compared with the older population, patients ≤ 45 years of age who underwent CABG had (1) a higher incidence of positive family history of CAD, (2) a higher likelihood of requiring an endarterectomy, and (3) lower operative mortality rate despite a slightly poorer ventricular function.

Key words: young coronary artery bypass graft patients, risk factors, endarterectomy, vessel severity

Introduction

Coronary artery disease (CAD) was not recognized as common among young patients in the pre-World War II era until Yater reported pathologic studies of soldiers who were killed in the service.[1] Subsequent studies further elucidated the nature of the disease, which had become more apparent in the younger groups. The incidence of CAD among these young patients varies from 3 to 6% of the entire population with CAD.[2] Past studies have documented that these young patients present with higher prevalence of risk factors,[1,3–5] and that the nature of their disease was more aggressive than in the older group.[6] These past studies gauged the severity of CAD on the basis of left ventricular ejection fraction, the numbers of vessels involved, and their degree of stenosis obtained from the results of the angiograms. These studies relied solely on the cardiac catheterization report for determination of vessel severity. The objectives of this study were (1) to compare the prevalence of CAD risk factors among young patients who underwent CABG with the older controls, and (2) to compare

Presented to Southern California Chapter, American College of Surgeons, Dana Point, Calif., on January 18, 1997.

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Received: June 3, 1998
Accepted with revision: August 24, 1998

the severity of CAD of the young group with the older control group based on preoperative variables (ejection fraction and number of diseased vessels) and intraoperative variables (size and requirement for endarterectomy).

Methods

From January 1984 to February 1996, 112 patients aged ≤45 years (Group 1) and 798 patients >45 years old (Group 2) underwent CABG at Harbor-UCLA Hospital. Data were collected by reviewing hospital charts and stored in a computerized data base for analysis. Each patient was summarized on the basis of the following risk factors: hypercholesterolemia, obesity (>20% ideal body weight), diabetes (insulin- or non-insulin-dependent), hypertension, smoking, and family history of CAD. In addition, history of prior myocardial infarction (MI) was also noted. Hypercholesterolemia was defined as >240 mg/dl. Hypertension was defined as systolic blood pressure >150 mmHg or considered to be present if patient had history of hypertension or was taking antihypertensive medications. Persons who had never smoked were considered as nonsmokers, where as those who had smoked previously or smoked currently were considered as smokers.

The severity of CAD was documented in terms of preoperative and operative variables. Preoperative variables included left ventricular ejection fraction, presence of left main disease, and number of diseased vessels. Operative variables included vessel size, number of grafts performed, requirement for endarterectomy, cardiopulmonary bypass time, and aortic cross clamp time. Ventricular dysfunction was categorized into four groups: >50% = normal, 40–49% = mild, 30–39% = moderate, <30% = severe. Intraoperative vessel size was determined objectively by sizing the lumen with 1 mm, 1.5 mm, 2 mm, or 2.5 mm probes into the arteriotomy. Left main artery was considered diseased if angiograms revealed >40% stenosis.

Data are presented as percentage or means ± standard deviation and are statistically compared for significant difference by chi-square and one-tailed Student's *t*-test. A p value of <0.05 was considered statistically significant.

Results

The results are tabulated in Tables I, II, and III.

Patient Characteristics (Table I)

Among patients >45 years old (Group 2), the average age was 59.1 ± 7.4 versus 40.7 ±3.7 for the younger patients (Group 1). In Group 1, 86.6% were male, compared with 66.8% in Group 2 ($p<0.05$).

Preoperative risk factors: Group 1 had a statistically significantly higher incidence of positive family history (68.5 vs. 51.2%), and significantly lower incidence of hypertension (62.7 vs. 81.5%), obesity (42.9 vs. 83.9%) and history of previous MI (54.5 vs. 94.6%).

Severity of Coronary Artery Disease (Table II)

Preoperative variables: Group 2 had a significantly higher incidence of left main disease (22.6 vs. 11.4%) than Group

TABLE I Risk factors among young (Group 1) versus old (Group 2) patients undergoing coronary artery bypass grafting

	Group 1	Group 2	p Value
Age (years)	40.7 ± 3.7	59.1 ± 7.4	
Sex: M/F	86.6/13.4	66.8/33.2	<0.05
Hypertension	62.7	81.5	<0.05
Smoking	81.3	70.7	NS
Diabetes	44.1	60.4	NS
Family history	68.5	51.2	<0.05
Hypercholesterolemia	74.2	75.6	NS
Obesity	42.9	83.9	<0.05
Previous MI	54.5	94.6	<0.05

Values are presented as percentages or mean with standard deviation.
Abbreviations: M = male, F = female, NS = not significant, MI = myocardial infarction.

TABLE II Severity of disease: Preoperative and operative variables between Group 1 and Group 2

	Group 1	Group 2	p Value
Presence of left main disease	11.4%	22.6%	<0.05
Ejection fraction			
>50%	54.3%	60.1%	
40–49%	20.4%	16.1%	
30–39%	17.5%	15.7%	
<30%	7.8%	8.1%	
Average ejection fraction ± SD	49.70 ± 16%	53.82 ± 19.4%	<0.05
Number of grafts			
1	6.4%	2.5%	
2	17.8%	9.4%	
3	27.3%	23.6%	
4	27.3%	37.8%	
5	15.5%	22.0%	
6	2.7%	4.7%	
7	0%	0.1%	
Average number of grafts ± SD	3.4 ± 1.3	3.8 ±1.1	<0.05
Size (mm)	1.58 ± 0.33	1.56 ± 0.23	NS
CPB (min.)	112 ± 50	126 ± 44	<0.05
ACC (min.)	78.9 ± 28.4	88.7 ± 31.5	<0.05
Endarterectomy performed	8.2%	3.0%	<0.05

Abbreviations: CPB = cardiopulmonary bypass time, ACC = aortic cross clamp time, SD = standard deviation, min = minute, NS = not significant.

TABLE III Operative complications in Group 1 versus Group 2

	Group 1	Group 2	p Value
Stroke	1.8	0.5	NS
Renal failure	0.9	0.3	NS
Death	1.8	6.3	<0.05

Values are presented as percentages of patients.

1. The distribution of the affected vessels in the younger patients was most commonly the left anterior descending (LAD) 90.4%, followed by the right coronary artery (RCA) 79.8% and the circumflex (Cx) artery 69.2%. Most of the younger patients had double- and triple-vessel disease with an average of 2.6 ± 0.72 diseased vessels per patient. The older group had statistically greater mean left ejection fraction (53.8 vs. 49.7%).

Operative variables: Group 2 had a significantly greater number of grafts per patient (3.8 vs. 3.4, $p < 0.05$). The size of the diseased vessel measured intraoperatively was similar (1.56 vs. 1.58 mm) in both groups. Group 1 patients were more likely to have a shorter pump and x-clamp time. Endarterectomy was performed almost three times more frequently in Group 1 patients (8.2 vs. 3.0%, $p < 0.05$). At times, the extent of the endarterectomies was considerable.

Operative Mortality and Complications (Table III)

Two deaths occurred in Group 1 for a mortality of 1.8%, which was significantly less than that in Group 2 ($p < 0.05$). The incidence of stroke and renal failure was similar in both groups.

Discussion

Previous studies yield mixed results regarding the incidence of risk factors in younger compared with older patients undergoing CABG. The present study shows an increased incidence of family history of CAD in patients ≤ 45 who undergo CABG, consistent with previous studies documenting a positive family history in about 70% of young patients with CABG.[7–9] Other studies report no difference in risk factors, including family history, between both groups.[10,11]

The present study showed a significantly lower incidence of hypertension, obesity, and previous history of MI among the younger than among the older patients. The younger patients in our study had a lower incidence of diabetes, but this was not statistically significant. Kelly *et al.*[12] noted that the incidence of hypertension and diabetes was low in young patients with CABG. However, other studies report a higher prevalence of risk factors among these patients, although there was no comparison with an older group.[13,14] Kelly *et al.*[13] ranked the risk factors of patients < 40 years with CABG as follows: smoking (93%), obesity (75%), positive family history of heart disease (59%), previous MI (53%), and elevated cholesterol level (49%). Smoking and family history were the top two risk factors in the study of young patients by French *et al.*[14]

Although positive family history in our study is the only risk factor significantly higher in incidence in Group 1 than in Group 2, smoking remained the risk factor with the highest incidence in Group 1. Five previous studies report an incidence of smoking ranging from 80.5 to 95% in the younger age group[7–9,11,13] and this appears to be the most prevalent risk factor for CABG in the younger as well as the older age groups.

In our study, Group 1 had a lower incidence of left main disease than Group 2. This correlates with a prior study[12] showing a 5 versus 9.2% incidence in the younger versus older patients. Our study found the most common vessel affected in Group 1 with CABG was the LAD followed by the RCA. This finding is confirmed in prior studies.[5,11,15] Our study also showed that most of the Group 1 patients undergoing CABG had double- and triple-vessel disease, correlating with several other studies.[7,8,10] However, in two other studies, most of the younger patients had single-vessel disease.[11,15]

Ejection fraction in our study was similar in the two groups and is consistent with previous studies. The average number of vessels grafted was lower in Group 1, with 54% of this population in the 3- or 4-graft range, whereas 60% of Group 2 was in the 4- or 5-graft range. Prior studies showed a much lower average number of grafts per patient in the younger group, ranging from 1.6 to 3.0 grafts per patient.[11,14,15]

The size of the diseased vessel measured intraoperatively was not significantly different between the two groups in our study. The incidence of performing an endarterectomy was significantly higher in Group 1 than in Group 2 (8.3 vs. 3.0%). This implies a greater severity of disease in younger than in older groups, and this agrees with our subjective impression.

The operative mortality of the younger patients in our study was significantly lower than that of the older patients (1.79 vs. 6.27%), paralleling the study of Cohen[16] in which the operative mortality was 4.9% for patients under age 36 and 7% for the older group. Other studies showed no operative deaths in the younger group,[6,7,13,17] while one study showed a higher mortality in the young group.[12]

Conclusion

Our study confirms the higher incidence of positive family history in patients ≤ 45 requiring CABG compared with older controls, but finds a lower incidence of hypertension, obesity, and previous history of MI. The main risk factor, as for older patients, remains smoking. Our study demonstrates a higher incidence of endarterectomy in the younger group. The younger population can be expected to have a lower mortality rate for CABG surgery. Young patients with coronary disease severe enough to require CABG are a unique subset with special characteristics that are different from older controls. Smoking may act to accelerate coronary disease at a younger age in patients with a genetic predisposition.

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