The Heart Surgery Forum #2004-1182
9 (1), 2006 [Epub December 2005]
doi:10.1532/HSF98.20041182

Online address: http://cardenjennings.metapress.com/link.asp?id=112496

Left Internal Mammary Artery Improves 5-Year Survival in Patients Under 40 Subjected to Surgical Revascularization

Marcin Malinowski,[1] Roman Mrozek,[1] Romuald Twardowski,[2] Jolanta Biernat,[2] Marek A. Deja,[1] Kazimierz Widenka,[1] Anna-Maria Dalecka,[2] Iwona Kobielusz-Gembala,[2] Piotr Janusiewicz,[1] Stanislaw Wos,[1] Krzysztof S. Golba[2]

[1]2nd Department of Cardiac Surgery and [2]2nd Department of Cardiology, Medical University of Silesia, Katowice, Poland

ABSTRACT

Background: The population of young patients under 40 requiring coronary bypass surgery is characterized by an extremely and unusually rapid progression of coronary heart disease. The aim of the present study was to assess the clinical status and quality of life in these patients after surgery in relation to the type of conduit used to revascularize the left anterior descending artery (LAD).

Methods: One hundred seventeen patients under 40 (range, 30-40 years) underwent coronary artery bypass grafting (CABG) at our institution between 1991 and 1999. Ninety-one patients received LIMA to LAD graft (group A), and in 26 patients the saphenous vein was used to graft this vessel (group B). Seventy-eight patients (63 in group A and 15 in group B) were assessed after a mean time of 71 ± 26 months. They were asked to fill out a questionnaire aimed at their subjective assessment of their quality of life as compared with their preoperative status.

Results: Five-year actuarial survival was higher in patients with LIMA to LAD graft (log rank test: $P < .004$). The functional status of patients in group B was significantly worse in comparison to group A: respectively, CCS 2.2 ± 1.1 versus 1.5 ± 0.7; ($P = .02$), NYHA 2.2 ± 1.1 versus 1.3 ± 0.5; ($P = .002$). Patients in group B more frequently required reinstitution of nitroglycerine treatment (93% versus 56%; $P = .025$). We failed to show differences between the 2 groups as far as subjective quality of life is concerned. In summary, 63% of patients perceived it to be worse, 29% to be better, and 8% felt it had not changed.

Conclusion: The use of LIMA is crucial in patients undergoing CABG under the age of 40 in order to achieve the best possible surgical results. Quicker recurrence of coronary disease symptoms is observed when a vein is used to graft the LAD. It may reflect an earlier progress of atherosclerosis in venous grafts.

INTRODUCTION

Clinically symptomatic coronary heart disease (CHD) in young adults (under 40) is usually associated with such risk factors as smoking, arterial hypertension, diabetes, and hypercholesterolemia [Trzeciak 2001]. The development of an aggressive, premature form of coronary disease may also indicate the importance of psychical stress and genetic factors in those patients. The treatment options include both pharmacotherapy and invasive approaches: percutaneous transluminal coronary angioplasty (PTCA), often supplemented with stent implantation, and surgical coronary artery bypass grafting (CABG) with the use of arterial and venous conduits.

The assessment of patients after CABG surgery has been the subject of multiple clinical trials, although most of them included elderly and middle-aged patients. The analyses of cardiopulmonary function and quality of life in young individuals after CABG surgery are scarce.

The aim of our study was to assess contractile and diastolic function of the left ventricle, CCS and NYHA functional status, and presence of coronary heart disease risk factors in this young age group (<40 years) with respect to the type of conduit (artery versus vein) used to graft the LAD.

MATERIALS AND METHODS

One hundred seventeen patients operated on in our institution between 1991 and 1999 were retrospectively analyzed. All but 1 patient underwent elective surgery for stable CHD. One patient operated on for unstable angina received left anterior mammary artery (LIMA) to LAD graft. The mean age of patients at the time of surgery was 37.2 ± 2.3 years (range, 30-40 years; 93% males). LIMA to LAD graft was constructed in 91 patients (group A), while in the remaining 26 (group B) a segment of saphenous vein (vein graft [VG]) was used to revascularize the LAD. One patient died in the early postoperative period. Thirty-eight patients were lost to follow-up, but we managed to collect mortality data from the municipal authorities. Thus, all patients were included in the survival analysis.

Received December 9, 2004; received in revised form September 27, 2005; accepted October 1, 2005.

Address correspondence and reprint requests to: Krzysztof S. Golba, MD, PhD, 2nd Department of Cardiology, Medical University of Silesia, ul. Ziolowa 47, 40-635 Katowice, Poland; 48-32-359-8542; fax: 48-32-252-6093 (e-mail: gcm-golbak@slam.katowice.pl).

Table 1. Clinical Characteristics and Risk Factors of CHD

	Group A LITA-LAD (n = 63)	Group B VG-LAD (n = 15)	*P*
Sex, F/M	5/58	1/14	1.0
Hypertension	30 (48%)	4 (26%)	.23
Diabetes	2 (3%)	0	1.0
Postoperative hyperlipidemia	50 (79%)	11 (73%)	.73
Smoking (preoperatively)	44 (70%)	13 (86%)	.33
Smoking (postoperatively)	7 (11%)	2 (13%)	.68
Number of grafts used	3.0±0.95	3.4±0.91	.14

The remaining 78 patients (63 from group A and 15 from group B) for the sake of this analysis were invited for the detailed assessment. Apart from determination of Canadian Cardiovascular Society (CCS) and New York Heart Association (NYHA) functional status as well as current pharmacotherapy, evaluation included an echocardiography examination and quality of life questionnaire. At the check up, the mean follow up time equaled 71 ± 26 months. The patients' clinical profiles and factors analyzed are presented in Table 1.

Quality of Life Assessment

Patients' quality of life was assessed based on a questionnaire that included 20 questions describing 4 domains: (1) how they felt and performed in society, (2) their family life, (3) physical performance, and (4) emotional status. The questionnaire was constructed in such a way that it was necessary to compare preoperative status with the current self-assessment. For each answer, –1 point was awarded in case of deterioration, 0 points when there was no change, and +1 point when a patient's self-assessment improved in given domain in comparison to pre-operative time. The sum of all scores from all answers (range, –20 to +20) was subjected to analysis. The need for repeat hospitalization for cardiac causes, professional activity, and the presence of coronary heart disease risk factors in the postoperative course were also analyzed.

Echocardiography

The echocardiography examination was performed with the use of a Hewlett Packard (Palo Alto, CA, USA) Sonos 2000 with a 2.5 MHz transthoracic transducer. Color coded pulsed Doppler was used for flow analysis. In the long axis, parasternal view, and M-mode the following parameters were measured: left atrial (LA) diameter, end-diastolic (EDD) and end-systolic (ESD) diameters of the left ventricle (LV), and end-diastolic (EDV) and end-systolic volumes (ESV) of the LV. Left ventricular ejection fraction (EF) was calculated using Simpson's method, which is a mean value of EF calculated in 2- and 4-chamber views. Segmental contractility was assessed based on the score system reflecting contractility of each segment of the LV (scores: 1, normal contractility; 2, hypokinesia; 3, akinesia; 4, dyskineasia; 5, aneurysm). The wall motion score index (WMSI) was calculated by dividing the sum of the scores by the number of segments analyzed [Otto 2002]. In addition, certain parameters reflecting diastolic function were analyzed: transmitral flow velocity in early-diastole (E wave) and late-diastole (A wave) and E to A ratio (E/A). Also, early inflow deceleration time (DTE) and isovolumic relaxation time (IVRT) were measured. E/A > 1, DTE > 200 ms, and IVRT > 90 ms were regarded as indices of diastolic dysfunction of the LV [Otto 2002]. Mitral regurgitation was assessed by dividing regurgitant wave area by the LA area. It was considered significant when the index exceeded 0.2 [Helmcke 1987].

Statistical Analysis

Data are presented as mean ± standard deviation (SD). Continuous data were compared with the use of the student *t* test or Mann-Whitney test. Chi square or the exact Fisher test were utilized to determine the frequency with which the particular parameter occurred in the analyzed group. The correlation analysis was performed based on Pearson's and Spearman's tests where appropriate. Survival rates were calculated by the Kaplan-Meier method and compared by log-rank test. In each case *P* values less than .05 were considered significant. SigmaStat 3.0 software (SPSS Inc., Cary, NC, USA) was used to perform all statistical tests.

RESULTS

One patient died in the early postoperative course (0.85%) and 10 other late deaths were noted (8.62%). Mean 5-year survival was 92% (Figure 1). Patients with VG to LAD had a significantly higher probability of death compared to those with the LIMA to LAD graft. Group analysis revealed a mean 5-year survival of 95% in group A and 80% in group B (log rank test: $P < .004$) (Figure 2).

Patients in group B developed symptomatic angina during follow-up more often than those in group A: CCS 2.2 ± 1.1 and 1.5 ± 0.7, respectively; $P = .02$. Those patients required reinstitution of nitrate therapy more frequently

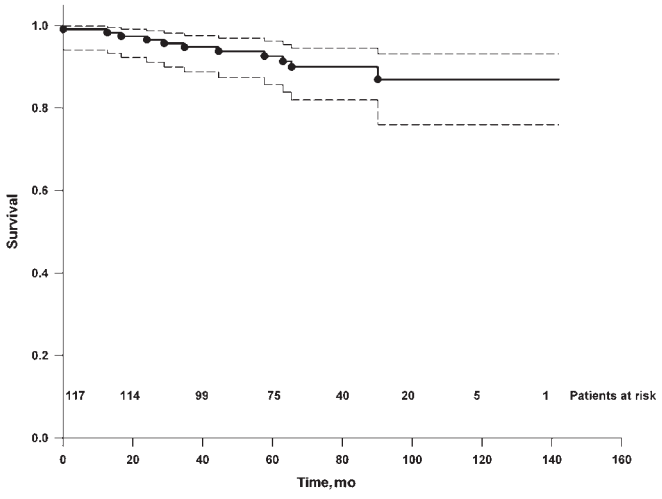

Figure 1. Kaplan-Meier survival curve for studied population with 95% CI.

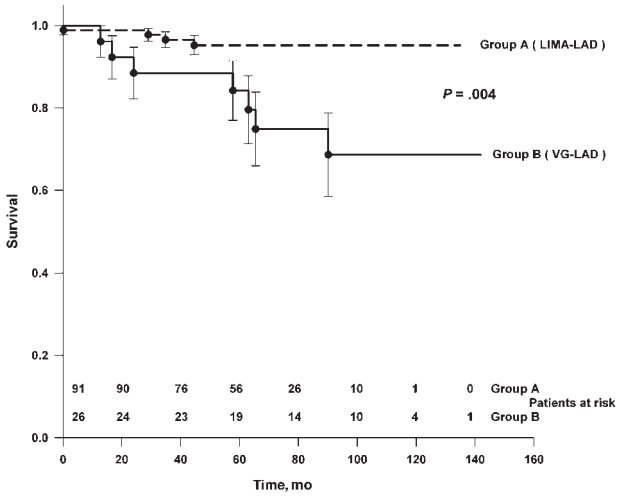

Figure 2. Kaplan-Meier survival curves depending on the type of graft to LAD.

(93% versus 56%, P = .025). As for other drugs, the differences between the two groups were not statistically significant. (Table 2).

Even though the differences in EF, LVEDV, and LVESV between the groups failed to reach significance, segmental contractility index was higher in patients with VG to LAD than with LIMA to LAD (1.4 ± 0.3 versus 1.2 ± 0.3, respectively; P = .03).

We failed to show the difference in the diastolic function parameters of LV between groups (Table 3). Their mean values revealed some diastolic dysfunction in the whole studied population. On average, IVRT was 90.6 ± 24.8 ms, exceeding normal values (> 90 ms) in 30 patients (38%). In 52 patients (66%), E/A ratio exceeded 1 (range, 0.57-3.18). E wave deceleration time ranged from 40 ms to 340 ms; in 13 patients (17%) it was longer than 220 ms and in 6% of them it was markedly prolonged (> 250 ms).

NYHA classification revealed that heart failure was significantly more advanced in patients in group B than in group A: 2.2 ± 1.1 and 1.3 ± 0.5, respectively; P = .002. The extent of heart failure symptomatology correlated positively with the degree of mitral regurgitation, as depicted by the ratio of regurgitant area and LA area (r = 0.374, P = .0008) and maximal transmitral flow velocity in late-diastole (A wave); r = 0.3, P = .008. The degree of heart failure according to NYHA classification was proportional to the LVEDDI (r = 0.25, P = .026) and RVDI (r = 0.3, P = .006).

The quality of life questionnaire showed an average score of –2.5 ± 6.3 in group A and –2.7 ± 4.7 in group B (P = .8). This indicates that majority of patients felt their quality of life deteriorated in comparison to preoperative status (61% versus 66%, respectively; P = 1.0). In fact, only 31% in group A and 20% in group B (P = .53) felt their quality of life improved, and 6% and 13%, respectively, (P = .32) perceived no change from before the operation. Among those who felt their quality of life was worse, 46% indicated the most negative scores in the emotional status domain. Twenty-six patients (41%) in group A and 8 (53%) in group B managed to return to professional activity (P = .56). However only 16 patients (61%) in group A and 5 (62%) in group B resumed exactly the same kind of job (P = .5)

In 19 patients (30%) in group A and 6 (40%) in group B there was a need for hospital readmission due to angina recurrence (P = .54). The frequency of hospital readmissions correlated well with quality of life scores in both groups (r = 0.45, P < .0001 ;r = 0.51, P = .049, groups A and B respectively.). We failed to show a statistically significant correlation of quality of life score with NYHA class in both groups (r = 0.13, P = .33 ; r = 0.05, P = .8, groups A and B respectively).

New myocardial infarctions occurred in 4 patients (6%) in group A and 3 (20%) in group B. These differences lacked statistical significance (P = .12). Repeated revascularisation procedures (either PTCA or CABG) were necessary in 3 cases (5%) from group A and 2 cases (13%) from group B (P = .24).

Table 2. Postoperative Medication

	Group A LITA-LAD (n = 63)	Group B VG-LAD (n = 15)	P
Nitrates	35 (56%)	13 (93%)	.025
Beta blockers	50 (80%)	10 (71%)	.31
Calcium antagonists	7 (11%)	4 (29%)	.2
Lipid lowering	37 (60%)	8 (57%)	.87
ACEI	23 (37%)	7 (50%)	.66
Diuretics	8 (13%)	3 (21%)	.43

Table 3. Echocardiographic Parameters of Systolic and Diastolic Function from Follow-up Examination*

	Group A LITA-LAD (n = 63)	Group B VG-LAD (n = 15)	P
EF, %	49.9 ± 10.7	45.2 ± 10.3	.13
WMSI	1.26 ± 0.3	1.41 ± 0.3	.03
ESV, mL	66.8 ± 32.0	77.2 ± 39.6	.28
EDV, mL	130 ± 45.2	136 ± 55.9	.64
EDD, mm	55.7 ± 5.6	56.6 ± 7.6	.9
ESD, mm	37 ± 6.8	40.2 ± 10.2	.21
LA, mm	36.8 ± 4.8	37.9 ± 6.7	.68
Mitral regurgitation	3 (5%)	2 (13%)	.24
E wave flow velocity, m/s	0.8 ± 0.23	0.76 ± 0.201	.73
A wave flow velocity, m/s	0.66 ± 0.149	0.76 ± 0.288	.28
E/A ratio	1.25 ± 0.427	1.08 ± 0.419	.15
DTE, ms	161.5 ± 57.12	158.2 ± 52.57	.84
IVRT, ms	90.3 ± 24.18	91.8 ± 28.36	.9

*EF indicates ejection fraction; WMSI, wall motion score index; ESV, end-systolic volume; EDV, end-diastolic volume; EDD, end-diastolic diameter; ESD, end-systolic diameter; LA, left atrial; E wave, early diastole; A wave, late diastole; DTE, deceleration time; IVRT, isovolumic relaxation time.

DISCUSSION

The role of surgical revascularization in coronary heart disease is well established and recognized. In the present paper we analyzed young patients who underwent surgical revascularization with the use of either venous or arterial grafts to the LAD. The decision about the use of either of those grafts was made exclusively by the surgeon, depending on his own experience and preferences. In the early 1990s it was still debatable whether all patients should receive LIMA. Some surgeons believed that, particularly in young patients, LIMA should be saved for future reoperation. With the growing evidence of LIMA superiority, the practice soon changed so that by the end of the 1990s nearly all patients received LIMA to LAD grafts in our institution. Therefore, group B is inevitably smaller. Bearing in mind this deficiency, we decided to perform this retrospective analysis because with the current practice one cannot hope for contemporary representative group of young adults with vein graft to LAD for comparative analysis.

Previously published data suggest that the LIMA to LAD graft is also the preferred choice in the young individuals, due to the excellent long-term patency [Loop 1977, Loop 1986, Olearchyk 1986].

We observed in our group a significantly higher probability of late death among patients with LAD grafted with a vein. This is concordant with results of Rohrer-Gubler, who demonstrated that using venous grafts in such young patients was an important risk factor of late death [Rohrer-Gubler 1998]. Also, French and coworkers concluded that failure to use IMA correlates with increased rate of late death [French 1995]. The retrospective analysis of long-term results of surgical revascularization procedures performed by Ng et al demonstrated that using IMA in young individuals substantially increases their survival [Ng 1997]. The paper of Loop clearly shows that the 10-year risk of death is 1.6 times higher among those with venous graft to the LAD in comparison to patients in whom LAD was grafted with IMA [Loop 1986]. What is interesting though, is that the survival analysis of our cohorts revealed significant differences as early as after the first 5 years after the operation. In the CASS registry, first differences were observed after 8 years [Cameron 1996]. Despite the fact that the CASS population was older than ours, generally the mean 5-year survival equal to 96% [Myers 1999] was superior to the survival data observed in our group (92%). Therefore our data confirm what Mayers et al found when they analyzed survival data of CASS population and demonstrated that young age at the time of surgery is a strong negative determinant of late survival [Myers 1999].

Most of our patients presented with one or more of the commonly recognized coronary heart disease risk factors, such as dyslipidemia, smoking history, and positive family history. A similar study was conducted by Zehr [1994], although dyslipidemia in his population was less frequent (37% to 52%). Others also point to a high prevalence of risk factors, also including arterial hypertension, diabetes, and smoking in this young group of patients [Nataf 1992, Graziosi 1994, French 1995, Trzeciak 2001].

A relatively small number of patients in our population was on lipid lowering therapy. Moreover, among those on therapy, in many cases the goals for LDL cholesterol (<100 mg/dL) were not fully achieved. Although there were no differences between groups, this factor may also have influenced the artherosclerosis progression rate in these young adults.

Half of the patients in group A and only 26% of those in group B had arterial hypertension. There were only 2 (3.1%) diabetic patients in group A (3.1%). Most of our patients quit smoking after surgery; this statistically important fact was also observed by other authors [Trzeciak 2001]. Frequent coexistence of multiple risk factors and positive family history allows us to assume that this young population (<40 years) is an example of patients with genetically determined coronary heart disease.

We found a statistically higher recurrence rate of ischemic symptoms in the group of patients with venous graft to the LAD, which was associated with an increased need for reinstitution of nitrate therapy. This reflects indirectly a faster progression of atheromatic processes in venous grafts. Zembala and Trzeciak also confirmed that the use of LIMA to graft the LAD in young individuals (mean age, 37.4 years) significantly decreases the rate of angina recurrence [Zembala 2002]. Echocardiographic studies revealed more advanced left ventricle regional contractility dysfunction in patients in group B, while other parameters reflecting LV systolic function remained unchanged. We failed to find differences in parameters describing LV diastolic function (E/A, DTE, IVRT) between groups; however, their mean values indicate a degree of diastolic dysfunction in the whole population studied. Nonetheless, the lack of correlation between the parameters mentioned above and the degree of heart failure described by NYHA class calls for great carefulness when it comes to the analysis. The degree of heart failure correlated well in both groups with the level of mitral regurgitation, the pattern of transmitral diastolic flow, and end-diastolic ventricular diameter.

The survey of quality of life demonstrated no improvement in 8% of patients in both groups. What is more striking though, in general, is that in as many as 63% of patients the quality of life deteriorated following coronary surgery. This data showed no association with the degree of heart failure, nor pathologies found on echo examination.

Frequently in analyzing such young populations, a successful return to professional life after surgery is considered an indicator of the quality of life [Graziosi 1994, Zehr 1994]. In our cohort, 41% of patients in group A and 53% in group B managed to resume professionally active lives. These values are slightly worse than reported previously [Laks 1978, Kelly 1998, Graziosi 1994, Zehr 1994]. Most resumed previous jobs (group A, 61%; group B, 62%). As many as 38% of patients were forced to take up lighter activities, a fact that Graziosi observed significantly less often (7% of cases) [Graziosi 1994]. It seems that the perceived deterioration of the quality of life could be associated with negative emotions resulting from the inability to continue work. This stresses the importance of proper postoperative care and rehabilitation programs that would enable coming back to normal professional life.

Definitely in our material those patients who required hospital readmission, with or without the need for revascularization, demonstrated poorer postprocedural quality of life. This finding was confirmed by Simchen and coworkers [2001], who demonstrated that the postoperative deterioration of quality of life is more frequent in women, patients with higher CCS scores, and those who were not enrolled in decent rehabilitation programs.

Our data confirm better survival among patients with LIMA to the LAD graft. This finding may denote that the use of arterial grafts in such young individuals has more impact than risk factors that influence the progression of coronary disease. If it were disease progression in those young patients that was a primary factor influencing late survival, then the curves would be similar.

Our conclusions are limited by the design of the analysis, which is a retrospective observational study. Another limitation is the fact that in each case the decision to use or not use LIMA was an individual decision of the surgeon. This decision was mostly influenced by his experience and approach he had toward type of grafts such young patients should receive. Moreover, we cannot exclude the possibility that better results observed in the group of patients with LIMA to LAD graft were influenced by other factors that we did not consider.

CONCLUSIONS

The use of the internal mammary artery to revascularize the left anterior descending artery is especially important in patients who are operated on before the age of 40. This strategy not only influences positively their late survival, but also allows for delaying the onset of the recurrence of anginal symptoms.

Coronary patients younger than 40 years old require particular attention paid to early and late postoperative care with the utmost effort taken to control the coronary disease risk factors.

REFERENCES

Cameron A, Davis KB, Green G, Schaff HV. 1996. Coronary bypass surgery with internal-thoracic-artery grafts—effects on survival over a 15-year period. N Engl J Med 334(4):216-9.

French JK, Scott DS, Whitlock RM, et al. 1995. Late outcome after coronary artery bypass graft surgery in patients < 40 years old. Circulation 92(9 Suppl):II14-9.

Graziosi GC, Wolterbeek DW, Kappetein AP, Huysmans HA. 1994. Risk factors in coronary artery bypass surgery for patients 40 years of age and younger. Thorac Cardiovasc Surg 42(5):259-63.

Helmcke F, Nanda NC, Hsiung MC, et al. 1987. Color Doppler assessment of mitral regurgitation with orthogonal planes. Circulation 75(1):175-83.

Kelly ME, DeLaria GA, Najafi H. 1988. Coronary artery bypass surgery in patients less than 40 years of age. Chest 94(6):1138-41.

Laks H, Kaiser GC, Barner HB, Codd JE, Willman VI. 1978. Coronary revascularization under age 40 years. Risk factors and results of surgery. Am J Cardiol 41(3):584-9.

Loop FD, Irarrazaval MJ, Bredee JJ, Siegel W, Taylor PC, Sheldon WC. 1977. Internal mammary artery graft for ischemic heart disease. Effect of revascularization on clinical status and survival. Am J Cardiol 39(4): 516-22.

Loop FD, Lytle BW, Cosgrove DM, et al. 1986. Influence of the internal-mammary-artery graft on 10-year survival and other cardiac events. N Engl J Med 314(1):1-6.

Myers WO, Blackstone EH, Davis K, Foster ED, Kaiser GC. 1999. CASS Registry long term surgical survival. Coronary Artery Surgery Study. J Am Coll Cardiol 33(2):488-98.

Nataf P, Parikh S, Rabago G, et al. 1992. Results of coronary artery surgery in young adults. J Cardiovasc Surg (Torino) 33(3):281-4.

Ng WK, Vedder M, Whitlock RM, et al. 1997. Coronary revascularisation in young adults. Eur J Cardiothorac Surg 11(4):732-8.

Olearchyk AS, Magovern GJ. Internal mammary artery grafting. Clinical results, patency rates, and long-term survival in 833 patients. J Thorac Cardiovasc Surg 92(6):1082-7.

Otto CM. 2002. The Practice of clinical echocardiography. 2nd ed. Philadelphia, PA: Saunders.

Rohrer-Gubler I, Niederhauser U, Turina MI. 1998. Late outcome of coronary artery bypass grafting in young versus older patients. Ann Thorac Surg 65(2):377-82.

Simchen E, Galai N, Braun D, et al. 2001. Sociodemographic and clinical factors associated with low quality of life one year after coronary bypass operations: The Israeli Coronary Artery Bypass Study (ISCAB). J Thorac Cardiovasc Surg 121(5):909-19.

Trzeciak P, Zembala M, Polonski L. 2001. Young adults undergoing coronary artery bypass grafting have multiple cardiovascular risk factors. Kardiol Pol 54:93-8.

Zehr KJ, Lee PC, Poston RS, Gillinov AM, Greene PS, Cameron DE. 1994. Two decades of coronary artery bypass graft surgery in young adults. Circulation 90(5 Pt 2):II133-9.

Zembala M, Trzeciak P. 2002. Operacje u mlodych z zaawansowana miazdzyca (in Polish). In Zembala M, Bochenek A and Wos S, eds. "Chirurgia naczyn wiencowych" PZWL.

REVIEW AND COMMENTARY

1. Editorial Board Member PB44 writes:

While this paper discusses a subject which, I believe, is noncontroversial in most surgeons' eyes, it does provide more evidence. Now of course, we really need the group who had stents placed to the LAD as a comparison!

(a) I have concerns about the small number with SVG to the LAD. There needs to be some comment regarding levels of lipids. Quite a small number were on lipid-lowering drugs by today's standard.

(b) The lack of statistical sigficance between the groups in many areas is a type II error.

(c) Of those having further interventions, how many required grafts other than the LAD?

(d) How agressive was the lipid-lowering therapy?

(e) What were the indications for a SVG to the LAD compared to an IMA?

(f) Was there a temporal change in use of IMA between 1991 and 1999?

Authors' Response by Dr. Marcin Malinowski:

We would like to thank the reviewers for their reviews and comments. We have attended to them in the revised version of manuscript. In particular we included points regarding graft selection bias and the lipid-lowering therapy in the discussion. Furthermore, following Editorial Board Member PB44's remark on type II error, we made sure to avoid categorical statements on the lack of differences in the article.

We agree with the reviewers that the data are based on a retrospective analysis of a relatively small number of patients; however, with the current practice of implanting LIMA to LAD in nearly all cases, collecting a prospective large group of patients for more powerful analysis does not seem feasible. We believe that with all its limitations our study adds to the understanding of the natural history of coronary artery disease in young adults.

Regarding Editorial Board Member PB44's comments:

(a), (b) We have to agree that the lack of statistical significance between the groups in many areas is due to a type II error. Unfortunately this is a retrospective analysis and we can only regret that the number in the vein graft group is not bigger.

Doing a prospective randomized study comparing LIMA-LAD and VG-LAD nowadays, although interesting, would not be ethical since we have more and more evidence that even in that age group using LIMA improves survival.

We completely agree that a rather small number of patients were on lipid-lowering therapy (statins especially). This indicates that not all risk factors were properly controlled in this population postoperatively. One could expect that the results might be different if anti-lipid therapy was more rigorously observed.

(c) There were 5 reinterventions: 1 CABG and 4 PCIs. Of those, only 1 did not require intervention to LAD territory and received PTCA to OM graft. Two patients had PCI to LAD, 1 to LAD and OM, and 1 received 2 grafts: to LAD and PDA.

(d) Ideally, lipid-lowering therapy should achieve goals of The Adult Treatment Panel III (ATP III) of the National Cholesterol Education Program (JAMA, 2001;285:2486-2497). All patients had CHD so the goal to attain should have been LDL cholesterol level <100 mg/dL.

We did not control medical therapy during follow-up and found that, by today's standards, in many patients it was inadequate. In our contemporary practice, every patient after CABG is started on HMG-CoA inhibitor on postoperative day 1. One has to remember that many patients in the study were operated on before the widespread use of statins.

(e), (f) The decision about whether to use LIMA or vein graft was only surgeon-dependent because all but 1 patient studied underwent elective coronary surgery. In fact, the patient with unstable angina received LIMA to LAD graft. In the early 1990s, some surgeons in our department still preferred vein to LIMA (having not much experience with arterial grafts or still not being convinced of their advantages). Growing evidence of the advantages of LIMA over vein to LAD at that time resulted in the continuous change over time in our daily practice toward more frequent use of arterial grafts. Finally, LIMA to LAD became a gold standard for all age groups.

2. Editorial Board Member AX44 writes:

The manuscript needs better explaination as to why group B did not get a LIMA. I expect there is selection bias involved that will reduce the importance of the observation.

This study is not randomized and should be viewed as suggestive at best. I believe the conclusion, but it is hard to make the case based on the "data" presented.

Authors' Response by Dr. Marcin Malinowski:

We totally agree that our study is only a retrospective nonrandomized analysis. Because all trials comparing LIMA and vein grafts to LAD were not especially aimed at that young age group, we wanted to point out that this group of patients possibly benefit more from using LIMA. Some surgeons previously thought that not using LIMA will "save" this graft when the patient is back later for, in their opinion, inevitable reoperation. We think that this kind of approach is not evidence-based and should be avoided.

Apart from making the point that the survival benefit of LIMA to LAD graft over the vein may be visible earlier in the young patients than it appears from the CASS Registry, for example, (N Engl J Med 1996;334(4):216-9), our paper shows generally less than optimal outcomes of the surgery in this young population, with the majority of patients being not satisfied with their quality of life and only half being able to return to work.