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ARTYKUŁ ORYGINALNY / *ORIGINAL ARTICLE*

Early and long term coronary artery bypass grafting outcomes in patients under 45 years of age

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Abstract

Background: In Poland, mortality and morbidity rates due to ischaemic heart disease (IHD) remain high and concern the whole population. An interesting issue is rapid development of IHD in some younger subjects and uncertain treatment outcomes in this patient subset. Premature cessation of professional activity, along with worsening of quality of life due to IHD in the population under 45 years of age is a huge medical, economic, and social problem. Only few studies evaluated early and long-term outcomes of coronary artery bypass grafting (CABG) used for the treatment of IHD in young patients, especially in premenopausal women.

Aim: The purpose of the study was to analyse early and long-term outcomes of CABG in patients under 45 years of age.

Methods: We studied 125 patients under 45 years of age who underwent a CABG procedure. The study group included 65 women aged 27–45 (mean 41.5 ± 3.5) years operated upon in 1990–1999, and 60 men aged 33–45 (mean 41 ± 3.2) years operated upon in 1993. We evaluated early postoperative outcomes. The two genders were compared in regard to survival free from death, recurrent angina, and repeated myocardial during long-term follow-up. We also evaluated other variables such as education level, professional activity, and exposure to IHD risk factors before and after the operation.

Results: Seven women and two men died in hospital after CABG ($p = 0.2$). Analysis of major postoperative outcomes like myocardial infarction, low cardiac output syndrome requiring support with intra-aortic balloon pump (IABP), a lower limb amputation following the use of IABP, ischaemic stroke, and respiratory failure showed that these complications were significantly more frequent in women than in men ($p < 0.01$). Differences between the two groups regarding other adverse outcomes including atrial fibrillation, sternal instability, haemothorax, and pneumothorax were not significant. Analysis of long-term survival curves did not show any significant differences between men and women in regard to rates of death, recurrent angina, and the need for repeated myocardial revascularisation ($p = 0.64$, $p = 0.93$, and $p = 0.13$, respectively).

Conclusions: Young women who underwent CABG were burdened with higher early postoperative morbidity and mortality than young men. However, long-term outcomes (mortality, recurrent angina, and repeated myocardial revascularisation rates) did not differ significantly between the two groups. Regardless of gender, repeated myocardial revascularisation rate was significantly higher among those patients who continued to smoke after the surgery ($p < 0.01$).

Key words: early and long-term outcomes, coronary artery bypass grafting, age under 45 years

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INTRODUCTION

Although ischaemic heart disease (IHD) is more common among men than women, particularly among middle-aged patients, cardiovascular diseases, including coronary artery disease (CAD) and cerebrovascular disease, remain a major cause of death among women in developed countries. Physicians have always underappreciated the importance of IHD in women as compared to men. In the recent years, women have become increasingly represented among participants of randomised clinical trials, while earlier trials included much

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larger percentages of men or were performed exclusively in men [1].

In many reports, patient gender is a factor affecting epidemiology, symptomatology, and outcomes in IHD. Women are at an increased risk of complications and worse outcomes following myocardial revascularisation [2, 3]. CAD is unusual in women before menopause. In the United States, myocardial infarction (MI) before 45 years of age is noted annually in about 3000 women and 123,000 men [4]. These data suggest that female hormones and metabolic pathways in menstruating women exert a protective effect on the cardiovascular system.

Most authors who considered age as a risk factor of adverse outcomes after coronary artery bypass grafting (CABG) indicated that both in-hospital and long-term mortality is higher among women [2, 3].

The aim of this study was to evaluate early and long-term outcomes in patients who underwent surgical myocardial revascularisation under 45 years of age.

METHODS

We studied 125 patients under 45 years of age who underwent CABG. The study group included 65 women aged 27–45 (mean 41.5 ± 3.5) years operated upon in 1990–1999, and 60 men aged 33–45 (mean 41 ± 3.2) years operated upon in 1993. We evaluated preoperative risk factors for IHD, periprocedural complications, and compared the two groups in regard to survival free from death, recurrent angina, and repeated myocardial revascularisation or coronary angiography during long-term follow-up. We also evaluated professional activity following CABG (i.e., return to work) and long term exposure to CAD risk factors.

Women with primary education only prevailed among female patients, while most men received secondary education (Table 1).

CABG surgery was performed using cardiopulmonary bypass and moderate hypothermia of 31–33°C. Cold crystalloid cardioplegia using St. Thomas' II cardioplegic solution was used to protect the myocardium. Left internal mammary artery (LIMA) was routinely used to revascularise left anterior descending (LAD) artery lesions. Complete revascularisation was performed in 91% of women and 90% of men. Overall, 348 bypass grafts were performed, mean 2.6 ± 1.1 in women and 3.13 ± 1.2 in men. A LIMA-LAD graft was used in 91% of women and 86% of men.

Men under 45 years of age who were operated in 1993 amounted to 19% of all patients operated due to IHD, while women who underwent CABG under 45 years of age amounted to 2% of the population of CABG patients in 1990–1999. Detailed data regarding the severity of angina and exposure to risk factors for IHD are showed in Table 2.

No statistically significant differences were found between the two groups in regard to angina severity categorised using the Canadian Cardiovascular Society (CCS) classification, dyspnoea severity as categorised using the New York Heart Association classification, number of previous MIs, and the severity of lesions found in coronary angiography. Similarly, the two groups did not differ significantly in regard to the exposure to IHD risk factors (cholesterol > 200 mg/dL, triglycerides > 180 mg/dL, glucose > 110 mg/dL, blood pressure > 140/80 mm Hg, body mass index, cigarette smoking) and the prevalence of chronic obstructive pulmonary disease which adversely affects outcomes after CABG. Body surface area (BSA) in women referred for CABG was significantly lower compared to men ($p < 0.001$). Sixty-eight percent of women had BSA below 1.8 m^2, and 23% below 1.6 m^2. Among women who died, BSA was 1.67 m^2, and five sixths of them had BSA below 1.8 m^2. Among men, BSA was 2.02 ± 0.4 m^2. Positive family history, defined as the occurrence of CAD in family members under 55 years of age, was significantly more frequent among women. Nine (13.8%) patients were already past menopause at the time of surgery, and oral contraception was used by 8 (12.3%) women.

Statistical analysis

Calculations were performed using the STATISTICA PL 9.0 package. Chi-square test with Yates correction was used. Survival curves in women and men were compared using the log-rank test. $P < 0.05$ was considered statistically significant.

Table 1. Study group characteristics

	Women	Men	P
Age	41.5 ± 3.5	41 ± 3.2	NS
< 36	5 (7.7%)	4 (6.7%)	
36–40	12 (18.5%)	17 (28.3%)	
41–45	48 (73.8%)	39 (65%)	
Education:			
Elementary	40 (61.5%)	7 (11.7%)	< 0.001
Secondary	22 (33.9%)	45 (75%)	< 0.01
Higher	3 (4.6%)	8 (13.3%)	NS

RESULTS

Seven women and two men died in hospital after CABG ($p = 0.2$) and although the difference was not significant, in-hospital mortality among women was increased 3.27-fold compared to men. Table 3 shows periprocedural complications in both groups. Again, although specific complications were more frequent among women, these differences were not significant. Overall, the combined rate of major procedural complications including perioperative MI, low cardiac output syndrome necessitating the use of intraortic balloon pump (IABP), a lower limb amputation following the use of IABP, ischaemic stroke, and respiratory failure was significantly in-

Table 2. Risk factors of ischaemic heart disease and clinical status before coronary artery bypass grafting (CABG)

	Women (n = 65)	Men (n = 60)	P
Smoking	62 (95.4%)	53 (88.3%)	NS
Cholesterol (> 200 mg/dL)	49 (75.4%)	45 (75%)	NS
Trigliceride (> 180 mg/dL)	9 (13.8%)	11 (18.3%)	NS
Body mass index > 26	37 (63.8%)	39 (70.9%)	NS
Hypertension (> 140/80 mm Hg)	27 (41.5%)	24 (40%)	NS
Family history	28 (43%)	40 (66.7%)	< 0.01
Menopause	9 (13.8%)	–	–
Contraceptive	8 (12.3%)	–	–
Diabetes (glucose > 110 mg/dL)	2 (3%)	1 (1.6%)	NS
Chronic obstructive pulmonary disease	2 (3%)	0	NS
Myocardial infarction	47 (72.3%)	36 (60%)	NS
Emergency CABG	18 (27.7%)	20 (33.3%)	NS
Body surface area	1.72 ± 0.15	2.02 ± 0.4	< 0.001
Body surface area > 1.8 m^2	44 (68%)	12 (20%)	< 0.001
Body surface area > 1.6 m^2	15 (23%)	2 (3.3%)	< 0.01
Ejection fraction	57.7 ± 9.8	53 ± 10	NS
CCS I	3 (4.6%)	4 (6.7%)	NS
CCS II	4 (6.1%)	8 (13.3%)	NS
CCS III	28 (43.1%)	30 (50%)	NS
CCS IV	30 (46.2%)	18 (30%)	NS
NYHA I	7 (10.8%)	15 (25%)	NS
NYHA II	28 (43.1%)	20 (33.3%)	NS
NYHA III	28 (43.1%)	25 (41.6%)	NS
NYHA IV	2 (3%)	0	NS
One-vessel disease	15 (23.1%)	12 (20%)	NS
Two-vessel disease	15 (23.1%)	20 (33.3%)	NS
Three-vessel disease	29 (44.6%)	28 (46.7%)	NS
Left coronary trunk stenosis	11 (16.9%)	6 (10%)	NS

Table 3. Perioperative complications

Complications	Men	Women	P	Total number of complications
Mortality	2	7	NS	
Perioperative myocardial infarction	2	9	NS	Major complications (p < 0.01)
Low cardiac output	6	13	NS	
Intra-aortic balloon pump (IABP)	4	10	NS	
Leg amputation after IABP	0	1	NS	
Respiratory insufficiency	1	1	NS	
Reoperation for bleeding	1	2	NS	
Supraventricular et ventricular arrhythmias	9	14	NS	Other complications (NS)
Hydrothorax	1	3	NS	
Sternal instability	3	3	NS	
Pneumothorax	1	1	NS	

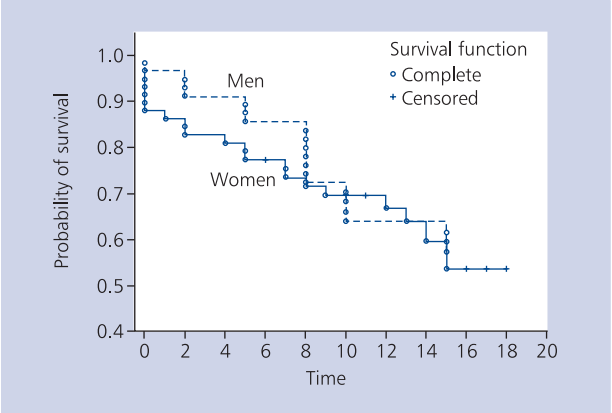

Figure 1. Probability of survival after coronary artery bypass grafting depending on gender. Survival curves did not differ significantly between women and men (log-rank test p = 0.6435)

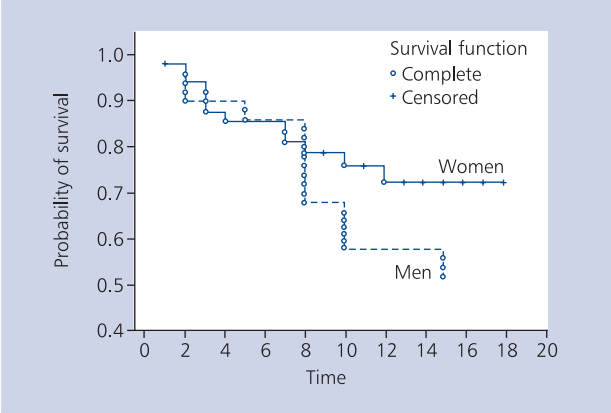

Figure 3. Probability of survival free from cardiac events after coronary artery bypass grafting. Survival curves did not differ significantly between women and men (log-rank test p = 0.1385)

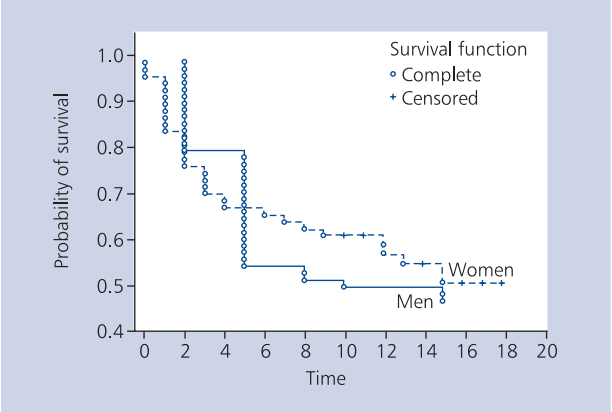

Figure 2. Probability of survival free from angina after coronary artery bypass grafting. Survival curves did not differ significantly between women and men (log-rank test p = 0.9391)

creased in women ($p < 0.01$). Differences between the two groups regarding other adverse outcomes including atrial fibrillation, sternal instability, haemothorax, and pneumothorax were not significant (Table 3).

Long-term survival free from death, recurrent angina, and the need for repeated myocardial revascularisation did not differ significantly between groups (p = 0.64, p = 0.93, and p = 0.13, respectively; Figs. 1–3).

During long-term follow-up, 2 men underwent repeated CABG. Repeated coronary angiography due to recurrent angina was performed in 12 women and 10 men. Among these patients, 9 women and 8 men continued to smoke. Percutaneous transluminal coronary angioplasty (PTCA) following CABG was performed in 6 women, who all continued to smoke, and 7 men, including 6 who continued to smoke.

We evaluated relationship between continuing exposure to IHD risk factors and the severity of angina as assessed using the CCS classification. Continued smoking was significantly associated with recurrent angina and/or worsening of the CCS class following surgery in both groups. No similar significant associations were shown for the remaining evaluated IHD risk factors (Table 4).

Five years after the surgery, 34% of women and 58% of men were professionally active. At the same time point during the follow-up, menopause occurring before 45 years of age was noted in 39.7% of women.

DISCUSSION

From the perspective of a cardiac surgeon, female patients require particular attention and increased pre- and postoperative care. As early as in 1985, Gardner et al. [5] reported significantly increased in-hospital mortality among women undergoing CABG, with a particularly high risk in patients

Table 4. Risk factors and clinical status Canadian Cardiovascular Society (CCS) classification after coronary artery bypass grafting

CCS	Smoking	Arterial hypertension	Diabetes mellitus	Cholesterol level > 200 mg/dL	Triglyceride level > 180 mg/dL	Body mass index > 25	Family history
Women	p < 0.01	NS	NS	NS	NS	NS	NS
Men	p < 0.01	NS	NS	NS	NS	NS	NS

under 45 years of age. Hogue et al. [6] evaluated 30-day postoperative survival and found a 3-fold increase in mortality in women under 50 years of age, and about 2-fold increase in mortality in women aged 50–70 years as compared to men of the same age.

Vaccarino et al. [2] performed a comparative analysis of more than 51,000 patients undergoing CABG. The main purpose of the study was to evaluate early postoperative mortality in women, with particular focus on patients under 50 years of age. In that study, in-hospital mortality among women was increased more than 1.8-fold compared to men undergoing CABG. The highest mortality among women compared to men was noted in patients under 50 years of age. In this group, in-hospital mortality in women was 3.04 times higher than in men. Similarly to the study of Vaccarino et al. [2] in an American population, Regitz-Zagrosek et al. [3] showed that relative mortality risk in European women compared to men decreased with age. In the youngest age group, relative mortality risk was increased about 2.4-fold in women, while no difference in mortality between men and women was noted among patients above 80 years of age. In addition, these authors identified a cutoff age of 70.5 years, above which neither gender nor age remained independent risk factors for mortality.

Similar conclusions were arrived at in the present study. Among young women, mortality was increased 3.27-fold compared to men, consistent with the result of other European and American studies [2, 3, 7, 8].

It is not entirely clear whether the observed difference in early mortality rates depends on the gender itself, or it also affected by other risk factors present in women at the time of referral for CABG.

In a long-term study by Herlitz et al. [9], patients were divided into two subsets, under and above 65 years of age. During a 5-year follow-up, female gender was associated with 2.1-fold increased mortality risk in the former group, while mortality risk among women relative to men was 1 in the latter group. The studied population of young patients did not differ significantly in regard to long-term mortality, the need for repeated myocardial revascularisation, and recurrent angina risk.

Worse outcomes after CABG in pre- and perimenopausal women compared to men under 50 years of age are evidenced by the number of complications following the surgery. In a retrospective study, Vaccarino et al. [2] noted significantly more postoperative complications in women compared to men. Neurological complications, renal failure, and MI in the first days after cardiac surgery were significantly more common among women. Of note, female gender, in contrast to male gender, was the most important adverse prognostic factor for complications following CABG in patients under 50 years of age. In the study by Hogue et al. [6], adverse cerebral events after cardiac surgery were significantly more common in women than in men (3.8% vs. 2.4%). The risk of new postoperative neurological complications in women under 50 years of age was increased 1.6-fold compared to men, and in women above 70 years of age it was increased 1.34-fold compared to men. In that study, the total number of complications after CABG was significantly higher in women compared to men, although differences in specific complication rates were not significant.

Probable mechanisms and hypotheses

A higher number of adverse risk factors present in young women at the time of their referral for CABG may indirectly lead to an increased early postoperative mortality compared to men. A particular role in this regard may be attributed to diabetes which is diagnosed significantly more commonly among young women referred for CABG. Premenopausal diabetic women show impaired diastolic function of the vessel walls and a reduced response of resistance vessel to adrenergic stimulation [10]. In premenopausal women, diabetes leads to similar endothelial dysfunction as in men with diabetes [11]. In addition, some nondiabetic women with normal blood glucose levels during oral glucose tolerance test show hyperinsulinaemia which is more prevalent among women with established IHD as compared to healthy women [12]. Tobacco use is another adverse prognostic factor in patients with IHD. The proportion of tobacco users is higher among men, but smoking combined with the use of oral contraceptives significantly contributes to the development and progression of IHD in young women [13, 14]. In our study, the need for PTCA after CABG was significantly increased in those patients who continued to smoke, both men and women.

In the Nurses' Health Study, age at the time of the last menstrual bleeding was found to be significantly associated with the risk of premature IHD [15], with the strongest association seen in women who used tobacco, and 95.4% of women in our study smoked before CABG. Bilateral oophorectomy due to medical reasons in premenopausal women is also associated with acutely decreased oestrogen levels, resulting in an increased incidence of IHD [16]. In our study, we did not analyse the causes of premature menopause but 39.7% of patients became menopausal before 45 years of age.

Polycystic ovary syndrome (PCO) is characterised by anovulatory cycles and hyperandrogenism. It has been estimated that PCO is present in about 6–10% of women of reproductive age [17], and diabetes develops before menopause in 15% of women with PCO [18]. In these patients, IHD risk is increased 4- to 11-fold compared to healthy women [19].

In contrast, the presence of oestrogen receptors in coronary artery smooth muscle cells is associated with a significantly lower prevalence of atherosclerotic lesions. The strongest association between vascular oestrogen receptor expres-

sion and the presence of atherosclerotic lesions has been observed in premenopausal women [20].

In women, intimal expression of the oestrogen receptor in the coronary arteries was found to be highest in the areas of lipid-rich plaques which are surrounded by zones of increased macrophage infiltration. Activation of the oestrogen receptor by oestrogens may be associated with overproduction of proteolytic enzymes, e.g. metalloproteinases synthesised by macrophages. This may result in plaque erosion, activation of the clotting cascade, and ultimately vessel occlusion [21].

Lack of the protective effect of oestrogens on the vascular system in menstruating women may be related to oestrogen receptor gene polymorphism. The c.454-397CC variant in the introne 1 of the ESR1 gene is associated with a 3-fold increase in MI risk compared to the c.454-397TT/CT variant [22].

Increased mortality among women after CABG relative to men may be related to intraoperative surgical challenges of purely technical nature. With smaller vessel diameter and a more tortuous course of the coronary arteries, vessel anastomoses are technically more demanding, which may lead to periprocedural complications. Despite similar patient characteristics in both groups, fewer coronary bypasses per patient were performed in women, possibly due to the fact that revascularisation of smaller vessels is attempted less frequently. Some authors suggested that women less frequently receive arterial grafts, which might result in worse outcomes regardless of the other factors. Nishida et al. [23] showed that arterial grafts are particularly beneficial when used to revascularise an area of myocardium supplied by small native vessels. Overall, the number of arterial grafts performed was larger in women than in men, possibly to the fact that all men were operated upon in 1993, and women were operated in 1990–1999, a period of a systematic rise in the use of arterial grafts. Early postoperative mortality increases in an inverse proportion to the coronary vessel diameter, but more so in women than in men [24]. During a long-term follow-up, women were found to have fewer patent venous grafts [25]. Of note, Sheifer et al. [26] indicated that compared to men, women have smaller vessels regardless of BSA. In our study group, women had significantly lower BSA, and five sixths of women who died soon after CABG had BSA below 1.8 m^2.

Limitations of the study

Notable limitations of the study included different periods in which patients of each gender underwent CABG, and different length of the follow-up period. We studied a group of men operated upon in 1993 and a group of women operated upon in 1990–1999. A decade is a long period for cardiologists, cardiac surgeons and anesthesiologists to accrue a large amount of experience regarding patient selection, surgical treatment, and overall management of patients undergoing CABG. Among men treated with CABG, 91.7% were followed up for 5 years, 83.3% for 10 years, and 80% for 15 years. It is difficult to present comparable follow-up rates for women treated with CABG, as they were operated in different years, and for some of them the total duration of follow-up has been less than 15 years. To compare follow-up in women and men, data collected in 2001 can be used, with the follow-up rate of 89.2%, and the mean time of 5.96 ± ± 2.5 years from the surgery. In 2008, the follow-up rate was 80%, and the mean time from the surgery was of 13.1 ± ± 2.55 years.

CONCLUSIONS

1. Among patients referred for CABG, women under 45 years of age were outnumbered by a factor of 10 by men of the same age.
2. Preoperative severity of risk factors was similar in both groups, except for significantly more common positive family history and significantly lower BSA in women.
3. Early mortality was increased 3.27-fold in women compared to men.
4. Overall rate of postoperative complications was significantly higher among young women.
5. Long-term survival free from death, recurrent angina, or the need for repeated myocardial revascularisation did not differ significantly between the two groups.
6. Five years after the surgery, 34% of women and 58% of men were professionally active, which may have been affected by education level and other non-medical socioeconomic factors at the turn of centuries.
7. Continued cigarette smoking is associated with worse clinical outcomes after CABG.

Conflict of interest: *none declared*

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Ocena wczesnych i odległych wyników leczenia chorych poddanych zabiegowi bezpośredniej rewaskularyzacji mięśnia sercowego do 45. rż.

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Streszczenie

Wstęp: W Polsce wskaźniki zachorowalności i śmiertelności z powodu choroby niedokrwiennej serca (IHD) są wciąż wysokie i dotyczą całej populacji. Interesującym problemem jest często zaskakująco szybki rozwój IHD w młodym wieku oraz niepewne rokowanie po zastosowanym leczeniu. Niewiele jest również opracowań na temat oceny wczesnych i odległych wyników terapii IHD w grupie młodych chorych, poddanych zabiegowi bezpośredniej rewaskularyzacji mięśnia sercowego (CABG), zwłaszcza kobiet przed menopauzą. Populacja pacjentów przed 45. rż. znajduje się w pełni aktywnego życia, pogorszenie komfortu życia i przedwczesna eliminacja z aktywnego trybu życia spowodowana IHD stanowi zatem ogromny problem medyczny, ekonomiczny i socjologiczny.

Cel: Celem pracy była ocena wczesnych i odległych wyników leczenia operacyjnego chorych poddanych CABG do 45. rż.

Metody: Badaniem objęto 125 chorych do 45. rż. poddanych CABG. W badanej grupie było 65 kobiet w wieku 27–45 lat (śr. 41,5 ± 3,5 roku), operowanych w latach 1990–1999 oraz 60 mężczyzn w wieku 33–45 lat (śr. 41 ± 3,2 roku) operowanych w 1993 r. Oceniono czynniki ryzyka IHD przed operacją, powikłania okołooperacyjne i wyznaczono dla obu grup chorych krzywe przeżycia obejmujące: zgon, pojawienie się bólów dławicowych, a także ponowną rewaskularyzację mięśnia sercowego w obserwacji odległej. Analizowano również poziom wykształcenia i aktywność zawodową przed i po operacji oraz narażenie na czynniki ryzyka postępu choroby wieńcowej w obserwacji odległej. Pełną rewaskularyzację mięśnia sercowego wykonano u 91% kobiet i 90% mężczyzn. Wszczepiono ogółem 348 pomostów (śr. 2,6 ± 1,1 u kobiet i 3,13 ± 1,2 u mężczyzn). Tętnicę piersiową wewnętrzną lewą wszczepiono u 91% kobiet i 86% mężczyzn. W omawianym okresie mężczyźni do 45. rż. stanowili 19%, a kobiety 2% ogółu chorych poddanych CABG. Przed operacją nie zanotowano istotnych statystycznie różnic w nasileniu dolegliwości dławicowych wg CCS oraz liczby przebytych zawałów serca. Nie występowały różnice w narażeniu na czynniki ryzyka wystąpienia IHD w obu grupach. Jedynie powierzchnia ciała kobiet kwalifikowanych do CABG była istotnie niższa ($p < 0,001$) w porównaniu z grupą mężczyzn.

Wyniki: Siedem kobiet i dwóch mężczyzn zmarło w szpitalu po CABG ($p = 0,2$). Po podsumowaniu powikłań ciężkich, takich jak: zawał okołooperacyjny, zespół małego rzutu z koniecznością zastosowania kontrpulsacji wewnątrzaortalnej (IABP), amputacja kończyny po IABP, udar niedokrwienny i niewydolność oddechowa, stwierdzono, że znamiennie częściej powikłania występowały po operacji w grupie kobiet ($p < 0,01$). W grupie pozostałych powikłań (migotanie przedsionków, ruchomość mostka, obecność płynu lub odmy w jamie opłucnej) różnice nie były istotne statystycznie. Odległe krzywe przeżycia obejmujące: zgon, pojawienie się dolegliwości dławicowych po operacji i konieczność ponownej rewaskularyzacji nie wykazały różnic istotnych statystycznie (odpowiednio: $p = 0,64$; $p = 0,93$ i $p = 0,13$). Pięć lat po operacji zawodowo pracowało 34% kobiet i 58% mężczyzn, co może wynikać z profilu wykształcenia oraz innych, pozamedycznych, czynników socjoekonomicznych na przełomie wieków.

Wnioski: Młode kobiety po CABG są obarczone większą śmiertelnością wczesną i statystycznie większą liczbą powikłań pooperacyjnych. W obserwacji odległej nie wykazano różnic w przeżywalności, obecności dolegliwości stenokardialnych i konieczności ponownej rewaskularyzacji serca w obu grupach. Ponowna rewaskularyzacja serca istotnie częściej ($p < 0,01$) dotyczyła chorych w obu grupach, którzy powrócili do nałogu palenia tytoniu po CABG.

Słowa kluczowe: wczesne i odległe wyniki leczenia, zabieg bezpośredniej rewaskularyzacji mięśnia sercowego, chorzy do 45. rż.

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