Independent predictors of early mortality after coronary artery bypass grafting in a single centre experience — does gender matter?

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Abstract

Background: It is commonly believed that women undergoing isolated coronary artery bypass graft surgery (CABG) are subject to a higher risk of perioperative complications and death.

Aim: To evaluate the effect of sex as a risk factor on early complications and mortality after isolated CABG performed with cardiopulmonary bypass, and to evaluate the profile of the risk determined by the patient's sex.

Methods: Data derived from 2,194 surgical procedures performed in the Department of Cardiac Surgery at the Medical University of Lodz between January 2009 and March 2011 was analysed. The database was constructed on the basis of retrospective analysis of variables contained in a form of the National Registry of Cardiac Surgery.

Results: Isolated CABG with cardiopulmonary bypass was carried out in 1,303 patients (59.4% of all procedures). Women constituted the minority of patients (24.2%), and were significantly older (mean age 67.3 vs. 62.8 years, $p < 0.001$). They more often suffered from concomitant diabetes (43.1% vs. 33.41%, $p = 0.003$), had impaired renal function (median eGFR 88.5 vs. 95.0 mL/min[1]/1.73 m^2, $p < 0.001$), and had a history of smoking in fewer cases (54.1% vs. 83.0%, $p < 0.001$). Internal mammary artery was more rarely used as arterial graft in the group of women (84.8% vs. 95.0%, $p < 0.001$). Women were subject to a higher risk of recent postoperative myocardial infarction (5.5% vs. 2.9%, $p = 0.03$) and required reoperation more rarely than men (4.5% vs. 8.1%, $p = 0.04$). Higher 30-day mortality was observed among women (7.6% vs. 2.8%, $p < 0.001$) and female sex appeared to be an independent predictor of death in the multiple logistic regression analysis (OR = 1.8; 95% CI 1.2–2.7).

Conclusions: Women undergoing isolated CABG are subject to higher 30-day mortality. Female sex is an independent risk factor for death after isolated CABG. Further studies are necessary to identify causes of differences in prognoses among women.

Key words: sex, risk factors, mortality, coronary artery bypass grafting, myocardial revascularisation

INTRODUCTION

Women constitute less than 30% of patients undergoing isolated coronary artery bypass grafting (CABG) [1, 2]. According to numerous reports, they are at a higher risk of death in the perioperative period compared to men [1, 3–8]. Different explanations of this phenomenon have been suggested. Some studies prove that female gender is per se independently associated with a worse prognosis in the perioperative period [1, 6, 7]. Many models evaluating perioperative mortality related to CABG, including the most commonly used European System for Cardiac Operative Risk Evaluation (EuroSCORE), in the old as well as the new version, consider gender as an independent risk factor [2, 9]. On the other hand, in compliance with some other studies, the effect of gender on prognosis can rely to a considerable degree on concomitant specific-to-female gender factors, among which are smaller

coronary vessels and the rarer performance of arterial bypass grafts [4, 5, 8, 10, 11]. The majority of investigations indicate significantly higher age of women at the time of isolated CABG, with more advanced and symptomatic ischaemic heart disease, and more frequent concurrent diabetes and congestive heart failure [3, 5, 6]. The return to everyday activity after the operation is slower in women and they more often develop perioperative depression [4]. All these factors are associated with a worse prognosis and additionally complicate any attempts to compare women to men.

In order to understand the differences in prognosis and results of treatment between men and women, data derived from our Department was analysed for the impact of gender on prognosis and the identification of risk factors related to female gender.

METHODS
Population study
The medical records of 2,194 consecutive patients operated on from 5 January 2009 to 25 March 2011 in the Department of Cardiosurgery of the Chair of Cardiology and Cardiosurgery at the Medical University of Lodz were retrospectively analysed. Patients who simultaneously underwent CABG and an operation on the valve or any other surgical procedure, or whose clinical records were incomplete (n = 105), were excluded from the study. Thus, the total number of patients in the study group was 1,197. They were divided into two groups: women (n = 290; 24.2%) and men (n = 907; 75.8%). The design of the study is presented in Figure 1.
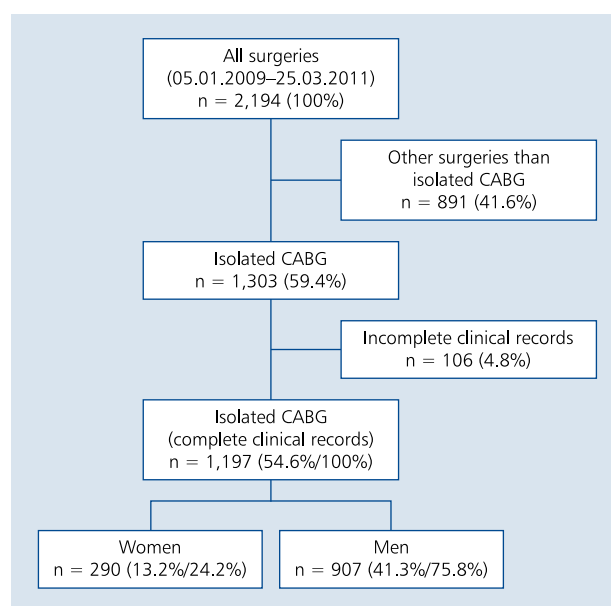

Figure 1. The design of the study; CABG — coronary artery bypass grafting

Surgical procedure
All patients were operated on via median sternotomy with cardiopulmonary bypass. The procedures were performed at normothermia with aortic clamping and cold cardioplegia. Patients received a heparin dose of 300 IU/kg to achieve the activated clotting time at the level of 480 s. Heparin activity was neutralised with protamine sulfate at a dose of 1 mg/100 IU of administered heparin.

Collection of data
Preoperative, intraoperative and postoperative variables were collected retrospectively based on the standardised form of the National Registry of Cardiac Surgery (KROK). The data collected included age, gender, body mass index (BMI), body surface area (BSA), estimated glomerular filtration ratio (eGFR) assessed with the Cockroft-Gault formula, ejection fraction (EF), logistic EuroSCORE, previous percutaneous coronary intervention (PCI) or CABG, Canadian Cardiovascular Society (CCS) class, New York Heart Association (NYHA) class, smoking, diabetes mellitus (DM), arterial hypertension, pulmonary arterial hypertension, hypercholesterolaemia, asthma, chronic obstructive pulmonary disease (COPD), atrial fibrillation (AF), vascular diseases, neurological dysfunctions, stroke, or transient ischaemic attack (TIA) in the history, mode of surgical procedure, left main stem stenosis (LMS) > 50%, number of narrowed vessels > 50%, number of distal anastomoses, use of internal mammary artery (IMA), intraaortic balloon pump (IABP), and type of complication.

All the figures were prospectively completed by the attending physician. The quality of data was routinely assessed while completing discharge cards, which allowed the clinicians to asess the correctness of the entered data. A lack of data in the record caused exclusion of a patient from the study. On the basis of the form of the National Registry of Cardiac Surgery (KROK), a computer database was built for further statistical analysis.

Statistical analysis
Categorical variables were presented as percentages. Continuous variables were reported as mean with standard deviation (SD) for variables with a normal distribution or as median with interquartile range (25–25 percentile) for variables without a normal distribution. Intergroup differences for continuous variables were analysed with the Student-t test for independent variables or with the Mann-Whitney's test depending on the variable distribution. The categorical variable analysis was performed with the χ^2 test and the χ^2 test with the Yates modification. Differences for the value of $p < 0.05$ were considered statistically significant.

For continuous variables for which a significant difference between the analysed groups was observed based on the analysis of curves of the receiver operating characteristic (ROC),

Table 1. Preoperative variables

Preoperative variable		Total (n = 1,197; 100%)	Women (n = 290; 24.2%)	Men (n = 907; 75.8%)	P
Age (IQR)		63 (58–71)	67 (61–74)	62 (57–69)	< 0.001
Age ≥ 65 years		535 (44.7%)	184 (63.5%)	351 (38.7%)	< 0.001
Body mass index [kg/m^2]		28.0 (35.4–30.7)	28.3 (25.3–30.9)	27.8 (25.4–30.5)	NS
Body surface area [m^2]		1.88 (1.73–2.01)	1.68 (1.56–1.78)	1.93 (1.82–1.94)	< 0.001
Body surface area < 1.8 m^2		413 (34.5%)	224 (77.2%)	189 (20.9%)	< 0.001
Ejection fraction [%]		53 (45–60)	55 (49–60)	52 (44–59)	< 0.001
Estimated glomerular filtration ratio [mL/min/1.73 m^2]		93.3 (74.4–115.9)	88.5 (70.7–109.7)	95.0 (75.6–117.0)	< 0.001
Estimated glomerular filtration ratio < 60 mL/min/1.73 m^2		117 (10.3%)	45 (16.3%)	72 (8.4%)	< 0.001
Diabetes mellitus		428 (35.8%)	125 (43.1%)	303 (33.4%)	0.003
Asthma		21 (1.8%)	6 (2.1%)	15 (1.7%)	NS
Chronic obstructive pulmonary disease		76 (6.4%)	18 (6.2%)	58 (6.4%)	NS
Arterial hypertension		1,053 (88.0%)	262 (90.3%)	791 (87.2%)	NS
Hypercholesterolaemia		1,087 (90.8%)	257 (88.6%)	830 (91.5%)	NS
Smokers		910 (76.0%)	157 (54.1%)	753 (83.0%)	< 0.001
Vascular diseases:	Total	115 (9.6%)	25 (8.6%)	90 (9.9%)	NS
	Peripheral	47 (3.9%)	11 (3.8%)	36 (4.0%)	NS
	Cerebral	72 (6.0%)	15 (5.2%)	57 (6.3%)	NS
Stroke and/or TIA in history		35 (2.9%)	8 (2.8%)	27 (3.0%)	NS
Arrhythmias:	Total	45 (3.8%)	10 (3.5%)	35 (3.9%)	NS
	AF	24 (2.0%)	3 (1.0%)	21 (2.3%)	NS
Previous interventions:	PCI	307 (25.7%)	73 (25.2%)	234 (25.8%)	NS
	CABG	3 (0.3%)	0 (0.0%)	3 (0.3%)	NS

IQR — interquartile range; TIA — transient ischaemic attack; AF — atrial fibrillation; NS — non-significant (p > 0.05)

optimal cut-off values allowing the prediction of death were determined. The optimal cut-off value was defined as a variable value, for which the sum of specificity was the highest.

To identify independent risk factors for death within 30 days, multiple logistic regression analysis was performed. Variables at the significance level of p < 0.1 in the univariate analysis were included into a further model. A backward stepwise logistic regression method for elimination of variables from the model was used. The odds ratio (OR) with 95% confidence intervals (CI) were calculated for independent predictors of death. In order to evaluate adjustment of the built model, the Hosmer-Lemeshow test was applied. A predictive value of the entire model was assessed on the basis of the area under the curve (AUC).

The whole statistical analysis was carried out by using MedCalc version 12.2.1.0 and STATISTICA version 10.0 with ZESTAW MEDYCZNY version 1.0.448.25105.

RESULTS

Isolated CABG surgeries were carried out in 1,303 of all 2,194 patients. Isolated CABG was the most frequently performed surgical procedure (59.4%) in our Department.

Women constituted the minority of operated-on patients (n = 290; 24.2%).

The characteristics of the main preoperative variables according to gender are presented in Table 1.

The median age of the analysed population was 63 (58–71) years (range: 34–88). Women were usually five years older than men. Of the group of patients above the age of 65 years, they were the definitely higher percentage (63.5%).

No statistically significant differences in the values of BMI were observed between the genders.

In the group of women, a statistically lower BSA was recorded compared to that of men. A total of 77.2% of women had BSA lower than 1.8 m^2.

Women were characterised by a significantly lower eGFR calculated with the Cockcroft-Gault method and nearly twice as frequent occurrence of chronic renal insufficiency (eGFR < 60 mL/min/1.73 m^2) than men.

Women statistically significantly more often suffered from DM (p = 0.003) compared to men. Insulin combined with oral drugs or in monotherapy was more frequently administered to women (women [W] = 61–21.0% vs. men [M] = 127–14.0%, p = 0.004) while treating DM. Only diet

therapy of DM (W =10–3.5% vs. M = 24–2.7%, p = 0.47) or oral antidiabetic drug therapy with diet (W = 51 [17.6%] vs. M = 144 [15.9%], p = 0.49) was used in both genders with comparable frequency.

No differences were observed between women and men in the incidence of asthma, COPD, arterial hypertension and hypercholesterolaemia.

Women smoked cigarettes significantly less frequently than men and there were more current smokers among men (W = 25/290 [8.6%]; M = 122/907 [13.5%], p < 0.001).

Concomitant diseases of peripheral and cerebral vessels occurred with a similar frequency in women as in men. Stroke and/or TIA were reported in 35 (2.9%) patients, with an equal distribution between both genders.

Women did not differ from men in the occurrence of preoperative rhythm disorders including AF, which were stated in 2.0% of patients prior to the operation.

There were no significant differences between females and males as regards previous coronary interventions, either PCI, which had been performed in every fourth patient in both groups, or CABG, performed in three patients.

Comparable percentages of patients of both genders (W = 62 [21.4%] vs. M = 171 [18.9%], p = 0.35) were in functional classes III or IV. Women experienced statistically significantly more severe angina symptoms. CCS class 3 or 4 was identified in 62.8% (n = 182) of women vs. 53.8% (n = 487) of men. Among all patients, there were two with acute circulatory failure (one man and one woman) and ten with acute coronary syndrome including two women and eight men.

Women did not differ significantly from men in terms of the incidence of LMS stenosis > 50% and three-vessel disease. The median of EF in the group of operated patients was 53 (45–60) and appeared to be significantly higher (55% vs. 52%, p < 0.001) in women. The characteristics of changes within the coronary vessels and the information on EF are shown in Table 2.

Women were not different from men regarding the duration of cardiopulmonary bypass, aortic cross-clamp and surgery. The mean number of CABG was lower in the group of women than in men (2.82 ± 0.75 vs. 2.98 ± 0.78; p = 0.003). Moreover, IMA (p < 0.001) as an arterial graft was significantly less frequently used in women. Women stayed longer in the Intensive Care Unit (ICU) than men (p < 0.001) and required longer mechanical ventilation (p < 0.047). Information on intra- and postoperative variables is presented in Table 3.

Complications were observed in 177 (14.8%) patients, without a significant difference in their frequency between women and men. In the group of women, more frequent incidence of recent postoperative myocardial infarction (MI) (p = 0.033) and more rare reoperations (p = 0.041) were reported. Detailed information on this subject is presented in Table 4.

To determine independent death predictors for the whole population studied, a model of the multiple logistic regression analysis with the backward stepwise regression method for elimination of variables was built. For continuous variables such as: the patient's age, time of performed surgery, time of aortic cross-clamping and total time of cardiopulmonary bypass based on the ROC curve analysis, optimal cut-off points were defined as the points of the highest sum of sensitivity and specificity for predicting the dependent variable — death within 30 days. Having performed the analysis of co-linearity, the following uncorrelated with each other variables were selected for further analysis: the age and time of cardiopulmonary bypass, characterised by the highest values of AUC (95 CI): AUC_{age} = 0.722 (0.643––0.801); $AUC_{time\ of\ cardiopulmonary\ bypass}$ = 0.713 (0.686–0.739). ROC curves are presented in Figure 2.

All variables with the significance level of p < 0.1 obtained in the univariate model were included into the multiple logistic regression model.

Independent predictors of 30-day mortality identified in the multiple logistic regression model are presented in Figure 3.

Table 2. Characteristics of changes within the coronary vessels and the ejection fraction of the left ventricle according to gender

	Total (n = 1,197; 100%)	Women (n = 290; 24.2%)	Men (n = 907; 75.8%)	P
Left main stem stenosis > 50%	303 (25.3%)	69 (23.7%)	234 (25.8%)	NS
One-vessel disease	29 (2.5%)	7 (2.5%)	22 (2.5%)	NS
Two-vessel disease	172 (14.5%)	44 (15.4%)	128 (14.2%)	
Three-vessel disease	970 (81.9%)	232 (81.4%)	738 (82.1%)	
Ejection fraction [%] (IQR):	53 (45–60)	55 (49–60)	52 (44–59)	< 0.001
< 30%	48 (4.0%)	5 (1.7%)	43 (4.7%)	< 0.001
30–50%	478 (39.9%)	91 (31.4%)	387 (42.7%)	
> 50%	671 (56.1%)	194 (66.9%)	477 (52.6%)	

IQR — interquartile range

Table 3. Intra- and postoperative variables (mean ± standard deviation/median interquartile range)

	Total (n = 1,303; 100%)	Women (n = 290; 24.2%)	Men (n = 907; 75.8%)	P
Time of cardiopulmonary bypass [min]	65.0 (52.0–81.0)	64.0 (53.0–80.0)	66.0 (52.0–83.5)	NS
Time of aortic cross-clamp [min]	33.0 (24.5–44.0)	32.0 (25.0–42.0)	34.0 (24.0–45.0)	NS
Time of surgery [min]	180.0 (150.0–210.0)	180.0 (150.0–215.0)	180.0 (150.0–210.0)	NS
Planned mode of surgery	1161 (97.15%)	283 (97.9%)	878 (96.9%)	NS
Internal mammary artery use	1108 (92.6%)	246 (84.8%)	862 (95.0%)	< 0.001
Number of distal anastomoses	2.94 ± 0.78	2.82 ± 0.75	2.98 ± 0.78	0.003
Time of mechanical ventilation [h]	19.2 (13.7–24.0)	20.6 (15.2–25.3)	19.0 (13.3–23.8)	0.047
Time of stay in Intensive Care Unit [days]	3.2 ± 5.7	3.9 ± 6.2	3.0 ± 5.6	< 0.001
Intra-aortic baloon pump — total:	30 (2.5%)	5 (1.7%)	25 (2.8%)	NS
Preoperative	1 (0.1%)	0 (0.0%)	1 (0.1%)	NS
Intraoperative	19 (1.6%)	3 (1.0%)	16 (1.8%)	NS
Postoperative	12 (1.0%)	2 (0.7%)	10 (1.1%)	NS

Table 4. Type of complications by gender and the odds ratio (OR) with 95% confidence interval (CI) of the incidence of a given complication calculated for the group of women

Complication	Total (n = 1,303; 100%)	Women (n = 290; 24.2%)	Men (n = 907; 75.8%)	P	OR (95% CI)
Reoperation	86 (7.2%)	13 (4.5%)	73 (8.1%)	0.04	0.54 (0.29–0.98)
Recent postoperative myocardial infarction	42 (3.5%)	16 (5.5%)	26 (2.9%)	0.03	1.98 (1.05–3.74)
Neurological	32 (2.7%)	7 (2.4%)	25 (2.8%)	0.92/NS	0.87 (0.37–2.04)
Respiratory	31 (2.6%)	10 (3.5%)	21 (2.3%)	0.40/NS	1.51 (0.70–3.25)
Hemorrhagic (tamponade and/or hemorrhage)	20 (1.7%)	5 (1.7%)	15 (1.7%)	0.86/NS	1.04 (0.38–2.90)
Multiorgan insufficiency	11 (0.9%)	3 (1.0%)	8 (0.9%)	0.91/NS	1.17 (0.31–4.46)
Infectious	6 (0.5%)	2 (0.7%)	4 (0.4%)	0.96/NS	1.57 (0.29–8.60)
Postoperative dialysis	6 (0.5%)	3 (1.0%)	3 (0.3%)	0.32/NS	3.15 (0.63–15.70)
Gastrointestinal	2 (0.2%)	1 (0.3%)	1 (0.1%)	0.98/NS	3.14 (0.20–50.28)
Total	177 (14.8%)	46 (15.9%)	131 (14.4%)	0.55/NS	1.12 (0.78–1.61)

The 30-day mortality rate was 3.9% and was higher for women (7.6% *vs.* 2.8%; p < 0.001). Causes of death were associated with cardiac complications, constituting 87.3% (n = 41) of all deaths.

DISCUSSION

There have been a number of reports indicating higher mortality and greater risk of unfavourable complications in the perioperative period among women compared to men [1–3, 6, 12–14]. According to some authors, being female is independently associated with a worse prognosis [1, 3, 7]. Moreover, the commonly used EuroSCORE, in its previous and current versions, considers female gender to be an independent negative prognostic factor [2, 9].

Bukkapatnam et al. [1] compared the results of treatment of 29,669 men and 10,708 women who underwent isolated CABG in 2003–2004. They demonstrated in multiple logistic regression analysis that female gender was independently associated with a higher death risk (OR 1.61; 95% CI 1.41–1.84). In a retrospective analysis, Blankstein et al. [3] evaluated 15,440 patients subjected to isolated CABG in terms of mortality. In the built multivariable model, in which all coexisting risk factors including BSA were considered, female gender also appeared to be an independent predictor of death. Edwards et al. [7] performed an extensive study in which they analysed data derived from the national database of the Society of Thoracic Surgeons including 247,760 men and 97,153 women and they also reported that female gen-
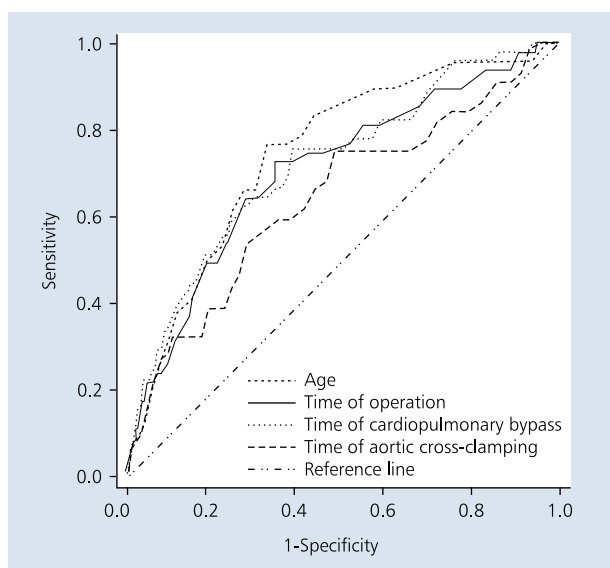
Figure 2. Receiver operating characteristic curve analysis — dependent variable as a death within 30 days

der was an independent predictor of death in a number of defined risk groups.

According to other researchers, female gender, when other concomitant risk factors are considered, is not independently associated with worse prognosis [10, 12]. Koch et al. [10] carried out analysis using the 'propensity score matching' method in which they adjusted the group of women and men in terms of risk factors. They proved that risk profiles considerably differ between genders and that gender does not negatively affect mortality in properly matched groups of men and women, but is only associated with a higher risk of postoperative MI (p < 0.001) and a longer time of mechani-

cal ventilation (p < 0.001) among women. However, the fact that only 26% of women were included in the current study, due to difficulties in adjusting a corresponding risk profile of male patients, is a serious limitation.

Special attention should be paid to the fact that various investigations evaluating the effect of gender on the results of treatment with isolated CABG use different sets of variables and statistical methods to determine the real impact of gender. Therefore, it is difficult to compare the results of the studies, and all these differences make researchers critically evaluate the outcomes.

In our single-centre study based on the analysis of 1,197 patients, including 290 women and 907 men, statistically significantly higher 30-day mortality was observed in the group of women (7.6% vs. 2.8%; OR 2.90; 95% CI 1.61–5.22, p < 0.001). After considering concomitant risk factors in the multiple logistic regression model, female gender still appeared to be an independent risk factor for death (OR 1.81; 95% CI 1.21–2.69). Statistical values of the Hosmer-Lemeshow test = 1.39 at p = 0.71 and AUC = 0.96 suggest a very good adjustment and predictive ability of the built model.

Comparison of preoperative variables shows statistically significant differences in concomitant risk factors between women and men. Women were on average five years older, more often suffered from diabetes, were characterised by significantly lower eGFR, and the majority of them had more advanced angina symptoms (CCS class 3 or 4). Men, however, in a higher percentage, smoked cigarettes and had worse EF. These differences, although not so numerous as in earlier reports, are in compliance with the results of previously published studies [1, 6, 8, 13] and confirm earlier outcomes that any direct comparison of women and men is subject to a relatively large error. A particularly significant difference

	Odds ratio (95% CI)	AUC (95% CI)	
Preoperative			
Women	1.81 (1.21–2.69)	–	
Age ≥ 68 years	2.16 (1.41–3.29)	0.75 (0.68–0.82)	
Arterial hypertenison	3.92 (1.20–12.83)	–	
Intraoperative and postoperative			
Time of cardiopulmonary bypass ≥ 72 min	1.86 (1.24–2.79)	0.72 (0.64-0.80)	
Intra-aortic balloon pump	2.75 (1.59–4.77)	–	
Concomitant complication	5.69 (3.57–9.07)	–	

Variables (p < 0.1) included into the multifactorial logistic regression model: gender, smoking, arterial hypertension, asthma, non-elective surgery, unstable angina, left main stem stenosis > 50%, intra-aortic balloon pump, time of cardiopulmonary bypass > 72 min, age > 68 years, renal failure (preoperative dialysis, acute or chronic renal failure), postoperative complications, body surface area < 1.8 m²
Hosmer-Lemeshow test = 1.390, p = 0.708; AUC = 0.957; R² Nagelkerk test = 0.523

Figure 3. Predictors of 30-day mortality identified with multiple logistic regression analysis; AUC — area under the curve; CI — confidence interval

between women and men, which could be earlier predicted, concerned significantly lower BSA in women. This factor is often neglected in the studies comparing isolated CABG in women and men, and according to some authors it plays a crucial role in the differences observed in postoperative mortality [13]. Wodds et al. [13] believed that BSA is very strongly correlated (r = 0.9) with the size of coronary arteries, which were measured during surgical procedures. But Sheifer et al. [15] have proven coronary arteries are smaller in women, irrespective of BSA. Smaller coronary vessels signify a greater technical difficulty at surgery, and this is why they are associated with a higher risk of postoperative complications and death. Technical difficulties at CABG in women can be evidenced by the observed lack of difference in the time of aortic cross-clamping between the group of women and men in the present study, with a lower mean number of performed distal anastomoses among females. According to some researchers, differences in BSA can be attributed to gender-related differences, although other authors dispute this [7, 8]. Taking into consideration the fact that the current study has not revealed an independent relationship between BSA and 30-day mortality, the results of our analysis bring into question the hypothesis suggesting that BSA is a prognostic parameter.

Other differences in intraoperative variables concerning women and men were also observed. In women, significantly less frequently was IMA used as an arterial graft, and the mean number of performed distal anastomoses was lower than in men. The findings of this study confirm the results of previous reports on significantly less frequent (84.8% vs. 95.0%; p < 0.001) application of IMA in the group of women [7, 12, 16]. It has been proven that arterial grafts are longer patent than venous ones [17]; and there have been some attempts to explain the differences in the treatment results by the fact of more rare use of IMA among women. However, a direct relationship between a lack of arterial grafts and early mortality still remains unclear, as some reports confirm an independent effect of not using IMA on worse prognosis [16, 18], and some others deny this relationship [7, 12]. However, according to the guidelines on myocardial revascularisation of the European Society of Cardiology (2010), arterial grafting to the left anterior descending artery has been recommended as the standard management (Ia) [19]. In the present analysis, the variable concerning IMA use did not fulfill the criteria (p < 0.1) and was not finally included in the multivariable model, because the outcomes of this study question the hypothesis indicating a worse early prognosis among patients in whom IMA was not used as graft.

Female gender was not associated with a higher incidence of postoperative complications. However, it was significantly associated with a higher risk of recent postoperative MI, and a lower risk of reoperation for any reason. A higher percentage of postoperative MIs was observed by Koch et al. [10] without indicating the cause of this phenomenon. It seems that a higher percentage of postoperative MIs among women may be explained by rarer IMA use and a lower mean number of performed distal anastomoses (p < 0.01) despite a lack of differences between women and men in the number of sclerotically changed coronary arteries. This reflects a lower percentage of complete revascularisations in the group of women, which results from a worse quality of grafts harvested from women, as suggested by Saxena et al. [6]. In the present study, however, graft quality has not been assessed.

A higher percentage of DM linked directly to the presence of disseminated sclerotic lesions in the coronary circulation and smaller vessels in women can be associated with the incidence of recent postoperative MI. This, according to Czech et al. [14], might be the cause of incomplete protection of the myocardium during aortic cross-clamping in this group of patients. In other studies, however, a higher percentage of postoperative MIs among women has not been reported [6, 12, 20]. Whereas, in compliance with the Chen et al. [21] study, MI in the perioperative period is associated with a two-fold increase in the length of stay at the ICU, which may partly explain longer mechanical ventilation and prolonged ICU stay in the group of female patients in our study.

Moreover, women significantly less frequently required reoperations for any reason (p = 0.041). Repeated opening of the chest is mainly performed because of haemorrhages, tamponade, sudden circulatory collapse, or considerable hypotension and the need for repeated sternal closure due to lack of stability or infection [22]. The present study did not contain information on all these variables, making determination of a direct cause of these differences difficult.

Nevertheless, no statistically significant differences in a higher incidence of haemorrhagic complications, being the most frequent cause of reoperation after isolated CABG in any group, were noted, which could suggest the cause of more frequent reoperations in the group of men. Thus, further studies are required to explain all these differences.

Limitations of the study

Our single-centre study, despite a rather large population, is not without limitations. Its main disadvantage is its retrospective character, which renders a detailed explanation of the more frequent reoperations among men impossible. The second problem, which has not been explained until now due to the retrospective character of the analysis, concerns a lower percentage of totally performed revascularisation procedures among women. A significant disadvantage is also a lack of data on detailed pharmacological treatment of patients, which limits the quality of our analysis compared to other reports. As mentioned before, an advantage of this study is the building of the logistic regression model and the value of the Hesmer-Lemeshow test describing this model at p = 0.71 and AUC = 0.96, which signify a very good adjustment and a considerable predictive strength. Nevertheless,

further prospective studies are necessary to verify the data obtained in the present analysis.

CONCLUSIONS

Isolated CABG in women is still associated with higher 30-day mortality. Women are subject to a greater number of concomitant risk factors (significantly higher age, DM, renal dysfunction) and they less frequently benefit from IMA use. Female gender appears to be an independent predictor of death. Other independent predictors of early mortality after CABG were: age ≥ 68 years, arterial hypertension, time of cardiopulmonary bypass ≥ 72 min, IABP, or the coexistence of complications. Further studies aimed at explaining the causes of higher mortality among women are required.

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Niezależne czynniki ryzyka wczesnej śmiertelności po izolowanym pomostowaniu tętnic wieńcowych w doświadczeniu jednego ośrodka — czy płeć ma znaczenie?

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Streszczenie

Wstęp: Powszechnie uważa się, że kobiety poddawane izolowanemu pomostowaniu aortalno-wieńcowemu (CABG) są obarczone większym ryzykiem okołooperacyjnych powikłań i zgonu.

Cel: Celem badania była ocena wpływu płci jako czynnika ryzyka wczesnych powikłań i śmiertelności po izolowanym CABG w krążeniu pozaustrojowym oraz ocena profilu ryzyka warunkowanego przez płeć pacjenta.

Metody: Analizie poddano dane pochodzące z wszystkich 2194 zabiegów wykonanych w Klinice Kardiochirurgii Uniwersytetu Medycznego w Łodzi w okresie między styczniem 2009 a marcem 2011 roku. Dla celów badania skonstruowano bazę danych opartą na retrospektywnej analizie zmiennych zawartych w formularzach Krajowego Rejestru Operacji Kardiochirurgicznych.

Wyniki: Izolowane CABG w krążeniu pozaustrojowym wykonano u 1303 pacjentów (59,4% wszystkich zabiegów). Kobiety stanowiły mniejszość (24,2%) i były starsze od mężczyzn (średni wiek 67,3 *vs.* 62,8 roku; p < 0,001). Istotnie częściej chorowały na cukrzycę (43,1% *vs.* 33,41%, p = 0,003), charakteryzowały się gorszą funkcją nerek (mediana eGFR 88,5 *vs.* 95,0 ml/min/1,73 m^2; p < 0,001) oraz rzadziej paliły tytoń (54,1% *vs.* 83,0%; p < 0,001). Tętnicę piersiową wewnętrzną rzadziej wykorzystywano jako pomost w grupie kobiet (84,8% *vs.* 95,0%; p < 0,001). Kobiety były obarczone wyższym ryzykiem wystąpienia ostrego zawału pooperacyjnego (5,5% *vs.* 2,9%; p = 0,03) oraz rzadziej wymagały reoperacji (4,5% *vs.* 8,1%; p = 0,04). Wśród kobiet zaobserwowano wyższą śmiertelność 30-dniową (7,6% *vs.* 2,8%; p < 0,001), a płeć żeńska w analizie wieloczynnikowej regresji logistycznej okazała się niezależnym predyktorem zgonu (OR = 1,8; 95% CI 1,2–2,7).

Wnioski: Kobiety poddawane izolowanemu CABG charakteryzują się wyższą śmiertelnością 30-dniową. Płeć żeńska jest niezależnym czynnikiem ryzyka zgonu po izolowanym CABG. Należy przeprowadzić kolejne badania w celu identyfikacji przyczyn odmienności w rokowaniu wśród kobiet.

Słowa kluczowe: płeć, czynniki ryzyka, śmiertelność, pomostowanie aortalno-wieńcowe, rewaskularyzacja mięśnia sercowego

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