Assessment of independent predictors for long-term mortality between women and men after coronary artery bypass grafting: Are women different from men?

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Objective: The long-term mortality of coronary artery bypass grafting in women in not certain. The purpose of this study was to determine and compare risk factors for long-term mortality in women and men undergoing coronary artery bypass grafting.

Methods: Between 1992 and 2002, 3760 consecutive patients (2598 men and 1162 women) underwent isolated coronary artery bypass grafting. Long-term survival data were obtained from the National Death Index (mean follow-up, 5.1 $\pm$ 3.2 years). Multivariable Cox regression analysis was performed, including 64 preoperative, intraoperative, and postoperative factors separately in women and men.

Results: There were no differences in in-hospital mortality (2.7% in men vs 2.9% in women, $P = .639$) and 5-year survival (82.0% $\pm$ 0.8% in men vs 81.1% $\pm$ 1.3% in women, $P = .293$). After adjustment for all independent predictors of long-term mortality, female sex was an independent predictor of improved 5-year survival (hazard ratio, 0.82; 95% confidence interval, 0.71-0.96; $P = .014$). Twenty-one independent predictors for long-term mortality were determined in men, whereas only 12 were determined in women. There were 9 common risk factors (age, ejection fraction, diabetes mellitus, $\geq$2 arterial grafts, postoperative myocardial infarction, deep sternal wound infection, sepsis and/or endocarditis, gastrointestinal complications, and respiratory failure); however, their weights were different between women and men. Malignant ventricular arrhythmias, calcified aorta, and preoperative renal failure were independent predictors only in women. Emergency operation, previous cardiac operation, peripheral vascular disease, left ventricular hypertrophy, current and past congestive heart failure, chronic obstructive pulmonary disease, body mass index of greater than 29, preoperative dialysis, thrombolysis within 7 days before coronary artery bypass grafting, intraoperative stroke, and postoperative renal failure were independent predictors only in men.

Conclusions: Despite equality between sexes in early outcome and superiority of female sex in long-term survival, there were 3 independent predictors for long-term mortality after coronary artery bypass grafting unique for women compared with 12 for men. Clinical decision making and follow-up should not be influenced by stereotypes but by specific findings.

The outcome of coronary artery bypass grafting (CABG) in men and women has been the object of intense debate in numerous studies. A higher early mortality (in-hospital or 30-day mortality) in women than in men after CABG has been observed by several researchers.[1-6] In addition, female sex is involved as a risk factor both in Society for Thoracic Surgeons risk modeling,[7] which is the largest cardiac surgery database in the world, and in the EuroSCORE algorithm,[8] which is one of the best-established and validated models for contemporary practice in cardiac surgery. However, female sex might simply be a marker

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Abbreviations and Acronyms
CABG = coronary artery bypass grafting
CI = confidence interval
HR = hazard ratio
OR = odds ratio

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of a high-risk profile,[9] and thus after adjustment for confounding factors, it is not an independent predictor of early mortality.[10-16]

There is also less known regarding long-term survival after CABG in women, and differences between female and male sex have been studied less extensively. Most recent studies with long-term outcome provide evidence that between 5 and 7 years after CABG surgery, the results are the same for women compared with those for men,[1,4,12,13,15,17] whereas few studies have shown a better long-term survival for women compared with men.[10,18,19]

The primary purpose of the present study was to determine and compare independent predictors for long-term mortality in women and men undergoing CABG. We also evaluated mortality between women and men both early and late after CABG surgery.

Patients and Methods
Patient Population and Data
Our study consisted of 3760 consecutive patients (2598 men and 1162 women) who underwent isolated CABG between January 1992 and March 2002 at the St Luke's–Roosevelt Hospital Center, a University Hospital of Columbia University. Data were prospectively collected during admission as part of routine clinical practice and entered into the New York State adult cardiac surgery report for the variables shown in Table 1. The definitions of the used variables were derived from the New York State adult cardiac surgery report, and we have mentioned some of them in our previous publications.[20-23] Risk stratification was performed according to EuroSCORE.[8]

Data Analysis
Long-term patient mortality data were obtained from the United States Social Security Death Index database (http://ssdi.genealogy.rootsweb.com). The sensitivity of the National Death Index to identify deaths is between 92% and 99%, depending on which identifiers are available.[24] Social Security number alone has the best accuracy of any combination of other identifiers (eg, first initial, last name, day of birth, month of birth, and year of birth), with a sensitivity of 97% and a specificity of 99%.[24] In this study we used only Social Security numbers, which were available in most patients (99.1%), and this allowed avoiding use of patients' names. In addition, patients without a Social Security number (n = 34) were censored at the time of discharge from the hospital. The Death Index was queried in September 2002, and patients not found there were assumed to be alive at that date.

Statistical Methods
Numeric variables were presented as the mean $\pm$ standard deviation and were compared with the independent Student t test or the Mann-Whitney U test where appropriate. Discrete variables were summarized by percentages and were compared with the Fisher exact test or the χ^2 test where appropriate. Kaplan-Meier survival curves were constructed for women and men and were compared with the log-rank test.[25]

The effect of female sex on 30-day mortality after CABG was determined by using logistic regression analysis.[26] All 64 preoperative, intraoperative, and postoperative variables were entered into the model. Variables were evaluated first univariately and then multivariately. The model selection was done with the backward stepwise method starting from all variables with a P value of less than .05 in univariate analyses. Female sex was forced to remain in the multivariate model, and odds ratios (ORs) and 95% confidence intervals (CIs) were calculated.

The effect of female sex on long-term mortality after CABG was determined by using Cox regression analysis.[27] In the whole database all 64 preoperative, intraoperative, and postoperative variables were entered into the model. Variables were evaluated first univariately and then multivariately. The model selection was done with backward stepwise method starting from all variables with a P value of less than .05 in univariate analyses. The model was then confirmed by using forward stepwise selection. Female sex was forced to remain in the multivariate model, and hazard ratios (HR) and CIs were calculated.

Independent predictors for long-term mortality after CABG were determined in men and women by using Cox regression analysis according to the procedure described above separately in the subgroup of men (n = 2598) and that of women (n = 1162). All analyses were performed with SPSS 11.0 software (SPSS, Inc, Chicago, Ill), and all P values are 2 tailed.

Results

Clinical Characteristics, Early Outcome, and Long-term Survival
A total of 3760 patients were operated on during the study period, including 1162 (30.9%) female patients and 2598 (69.1%) male patients. During 19,335 person-years of follow-up (mean follow-up, 5.1 $\pm$ 3.2 years), 764 (20.3%) deaths were recorded. Patient and disease preoperative, intraoperative, and postoperative characteristics are summarized in Table 1. Women had higher EuroSCOREs, were