Comparison of Results of Coronary Artery Bypass Grafting Versus Percutaneous Coronary Intervention in Octogenarians

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The aim of the present study was to compare the outcomes after coronary artery bypass grafting (CABG) and percutaneous coronary intervention (PCI) in patients aged ≥80 years. The present analysis included 274 patients who underwent isolated CABG and 393 patients who underwent PCI. The patients undergoing PCI had a greater prevalence of a history of cardiac surgery and recent myocardial infarction and had more frequently undergone emergency revascularization. Patients undergoing CABG had a significantly greater prevalence of 3-vessel coronary artery disease. The unadjusted 30-day mortality rate was 8.8% after CABG and 7.4% after PCI (p = 0.514). However, on multivariate analysis, CABG was associated with a significantly increased risk of 30-day mortality (odds ratio 2.246, 95% confidence interval 1.141 to 4.422). The unadjusted overall intermediate survival was significantly poorer after PCI (at 5 years, CABG 72.2% vs PCI 59.5%, p = 0.004), but this was not confirmed on multivariate analysis. PCI and CABG had similar intermediate survival rates when adjusted for propensity score (p = 0.698), a finding confirmed by the analysis of 130 propensity score-matched pairs (at 5 years, CABG 66.4% vs PCI 58.9%, p = 0.730). In conclusion, the survival of patients aged ≥80 years undergoing CABG is excellent, and the suboptimal survival after PCI seems to be related to the disproportionately greater risk of these patients compared to those undergoing CABG. When adjusted for important clinical variables, PCI and CABG achieved similar intermediate results. **(Am J Cardiol 2012;110:1125–1129)**

Data from the United Nations have indicated that by 2050 the >80-year age group is projected to reach 379 million worldwide, about 5.5 times as many in 2000, when there were 69 million persons aged ≥80 years.[1] Coronary revascularization procedures are becoming more common in this age group with the increasing numbers of persons aged ≥80 years, as well as because of the favorable outcomes of octogenarians after coronary artery bypass grafting (CABG) and percutaneous coronary intervention (PCI).[2] The use of PCI in these high-risk patients is attractive because of its minimally invasive nature and its somewhat lower operative mortality.[2] However, CABG has been shown to achieve excellent intermediate survival.[3,4] Whether PCI is superior to CABG in patients aged ≥80 years is largely unknown, and we investigated this issue in the present study.

Methods

The present study included a consecutive series of 274 patients who underwent isolated CABG at the Oulu University Hospital and Turku University Hospital, Finland, from January 2001 to January 2011 and 393 consecutive patients who underwent PCI at the Turku University Hospital, Finland, from January 2002 to January 2011. All the patients were aged ≥80 years. The ethics committee of our institutions approved the study protocol. Data on the cause and date of death for all patients were retrieved from the Finnish National Registry Statistics Finland. The mean follow-up was 3.6 ± 2.6 years. The cause of late death was unknown for 9 patients (2.3%) who had undergone PCI and for 7 patients (2.6%) who had undergone CABG, and these were considered noncardiac deaths for the present analysis. The main outcome end points of the study were cardiac and all-cause mortality.

Statistical analysis was performed using PASW, version 18 (IBM SPSS, Chicago, Illinois). Fisher's exact test, the Mann-Whitney *U* test, and the Kaplan-Meier test were used for univariate analysis. Multivariate analysis was performed using logistic and Cox regression analyses with backward selection by including variables with p <0.05 on univariate analysis. The treatment groups differed with respect to the pretreatment covariables. Therefore, the propensity score was calculated by logistic regression analysis with backward selection by including the clinical variables with p <0.20 on univariate analysis. This was used for 1-to-1 matching and for adjustment of the risk in the overall series. One-to-one propensity score matching between the study groups was done with a caliber width (0.06) estimated according to Austin.[5] p Values <0.050 were considered statistically significant.

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Table 1
Baseline characteristics, operative data, and survival of patients aged ≥80 years

Variable	Overall Series			Propensity Score-Matched Pairs		
	CABG Group (n = 273)	PCI Group (n = 392)	p Value	CABG Group (n = 130)	PCI Group (n = 130)	p Value
Age (years)	82.0 ± 1.7	83.3 ± 2.5	<0.0001	82.5 ± 2.0	82.6 ± 2.1	0.808
Women	107 (39%)	193 (49%)	0.010	48 (37%)	59 (45%)	0.166
Serum creatinine (mg/dl)	89 ± 24	94 ± 52	0.508	90 ± 25	102 ± 71	0.178
Pulmonary disease	34 (13%)	39 (10%)	0.271	13 (10%)	16 (12%)	0.555
Extracardiac arteriopathy	28 (10%)	31 (8%)	0.275	20 (15%)	12 (9%)	0.131
Diabetes mellitus	47 (18%)	88 (22%)	0.124	33 (25%)	25 (19%)	0.233
Hypertension	182 (68%)	273 (70%)	0.588	92 (71%)	92 (71%)	1.000
Stroke	15 (6%)	25 (6%)	0.663	10 (8%)	12 (9%)	0.656
Neurologic dysfunction	9 (3%)	5 (1%)	0.100	6 (5%)	1 (1%)	0.120
Previous percutaneous coronary intervention	23 (9%)	42 (11%)	0.367	16 (12%)	13 (10%)	0.541
Previous cardiac surgery	4 (2%)	31 (8%)	<0.0001	4 (3%)	3 (2%)	1.000
Coronary arteries narrowed (n)			<0.0001			0.488
1	5 (2%)	83 (21%)		5 (4%)	3 (2%)	
2	30 (11%)	170 (43%)		27 (21%)	34 (26%)	
3	238 (87%)	139 (36%)		98 (75%)	93 (72%)	
Left main stenosis	118 (43%)	119 (43%)	0.961	56 (43%)	48 (51%)	0.268
Left ventricular ejection fraction ≤50%	72 (26%)	105 (27%)	0.906	45 (35%)	32 (25%)	0.077
Myocardial infarction <3 mo	154 (56%)	303 (77%)	<0.0001	91 (70%)	84 (65%)	0.355
Emergency procedure	26 (10%)	125 (32%)	<0.0001	23 (18%)	24 (19%)	0.872
Beating heart surgery	106 (39%)	—	—	3 (4%)	—	—
≥1 Mammary artery graft	224 (82%)	—	—	99 (76%)	—	—
No. distal anastomoses	3.3 ± 1.0	—	—	3.1 ± 1.1	—	—
Vessels treated by percutaneous coronary intervention	—	1.2 ± 0.4	—	—	1.2 ± 0.5	—
Drug-eluting stents (n)	—	106 (27%)	—		35 (27%)	—
Short and intermediate overall survival			0.004			0.730
30 day	91.2%	92.6%		89.2%	92.3%	
1 year	87.5%	86.0%		83.1%	86.2%	
3 years	80.4%	71.6%		71.3%	69.7%	
5 years	72.2%	59.5%		66.4%	58.9%	

Continuous variable are reported as mean ± SD.
Definition criteria were according to the European System for Cardiac Operative Risk Evaluation criteria.

Table 2
Predictors of all-cause mortality in patients aged ≥80 years

Variable	Univariate Analysis (p Value)	Multivariate Analysis (HR, 95% CI)
Procedure type*	0.004	—
Age	<0.0001	1.118, 1.056–1.183
Serum creatinine	<0.0001	1.006, 1.004–1.008
Pulmonary disease	0.008	1.941, 1.344–2.804
Diabetes	0.001	1.627, 1.193–2.218
Recent myocardial infarction	<0.0001	1.606, 1.163–2.217
Ejection fraction ≤50%	0.004	—
Neurologic dysfunction	0.027	2.575, 1.254–5.289
Extracardiac arteriopathy	0.002	1.557, 1.045–2.319
Emergency procedure	<0.0001	1.644, 1.202–2.249

CI = confidence interval; HR = hazard ratio.
* PCI versus CABG.

Table 3
Predictors of cardiac mortality in patients aged ≥80 years

Variable	Univariate Analysis (p Value)	Multivariate Analysis (HR, 95% CI)
Procedure type*	0.187	—
Age	<0.0001	1.113, 1.035–1.197
Serum creatinine	<0.0001	1.006, 1.004–1.008
Pulmonary disease	0.049	1.928, 1.173–3.171
Diabetes	0.001	1.593, 1.060–2.393
Recent myocardial infarction	0.050	—
Ejection fraction ≤50%	0.003	—
Emergency procedure	<0.0001	1.925, 1.284–2.886

Abbreviations as in Table 2.
* PCI versus CABG.

Results

The patients undergoing PCI were significantly older and more frequently had a history of cardiac surgery, had had a recent myocardial infarction, and had required emergency revascularization (Table 1). Patients undergoing CABG had a significantly greater prevalence of 3-vessel coronary artery disease (Table 1).

The 30-day mortality rate was 8.8% after CABG and 7.4% after PCI (p = 0.514). Diabetes (p = 0.018), an emergency procedure (p <0.0001), and serum creatinine (p <0.0001) were independent predictors of 30-day mortality on logistic regression analysis. When the procedure was adjusted for the latter variables, CABG (odds ratio 2.246,

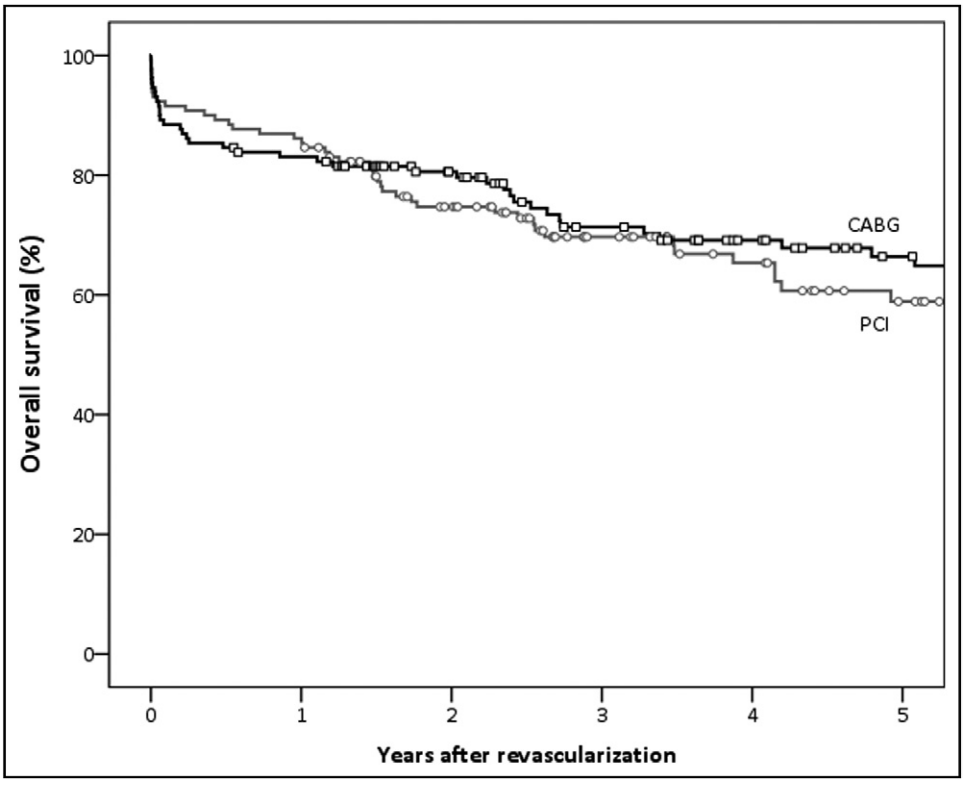

Figure 1. Kaplan-Meier estimates of overall survival in 130 propensity-matched pairs of patients aged ≥80 years who underwent CABG or PCI (log-rank p = 0.730).

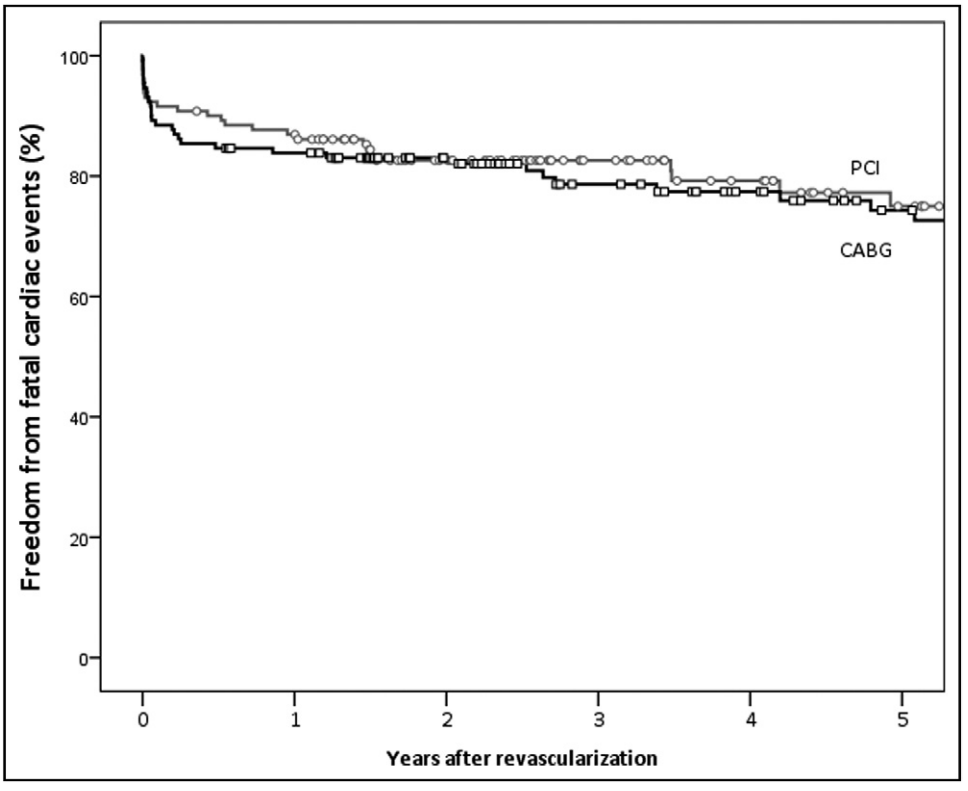

Figure 2. Kaplan-Meier estimates of freedom from fatal cardiac events in 130 propensity-matched pairs of patients aged ≥80 years who underwent CABG or PCI (log-rank p = 0.648).

95% confidence interval 1.141 to 4.422; p = 0.019), serum creatinine (odds ratio 1.019, 95% confidence interval 1.009 to 1.029; p <0.0001), and emergency procedure (odds ratio 4.725, 95% confidence interval 2.389 to 9.346; p <0.0001) were significantly associated with an increased risk of 30-day mortality (area under the receiver operating characteristics curve 0.747, 95% confidence interval 0.671 to 0.823; p = 0.296, Hosmer-Lemeshow test).

On univariate analysis, PCI was associated with significantly poorer overall survival (p = 0.004; Table 2), although the freedom from fatal cardiac events was similar between the study groups (p = 0.187, Table 3). Cox regression analysis showed that the treatment methods did not affect either all-cause mortality or cardiac mortality (Tables 2 and 3).

Logistic regression analysis showed that age (p < 0.0001), previous cardiac surgery (p <0.0001), number of diseased vessels (p <0.0001), recent myocardial infarction (p <0.0001), and emergent procedure (p <0.0001) were independent predictors of being assigned to PCI or CABG (area under the receiver operating characteristics curve 0.870, 95% confidence interval 0.843 to 0.897; p = 0.048, Hosmer-Lemeshow test). When adjusted for propensity score, PCI and CABG had similar intermediate all-cause (p = 0.698) and cardiac (p = 0.895) mortality. Propensity score matching resulted in 130 pairs of patients undergoing either CABG or PCI with similar baseline characteristics (Table 1). The intermediate overall mortality (p = 0.730, log-rank test; Table 1 and Figure 1) and freedom from fatal cardiac events (p = 0.648, log-rank test; Figure 2) were similar between the study groups. Such findings did not change even when the treatment method was adjusted for the baseline serum creatinine, a left ventricular ejection fraction ≤50%, and the number of diseased vessels (PCI vs CABG, all-cause mortality, p = 0.948, cardiac mortality, p = 0.428).

Discussion

Although increased age is a well-known risk factor for adverse events after invasive procedures, satisfactory early and late survival have been reported for patients aged ≥80 years after major cardiovascular surgery.[2,3,6–9] Increasing evidence has shown the benefits of invasive treatment of coronary artery disease in the elderly. PCI in octogenarians seems to be associated with good early and intermediate results,[2,10] and the long-term results after CABG can be even better.[3,4,11,12] Despite these encouraging results, physicians could still be reluctant to refer very elderly patients for invasive treatment of coronary artery disease[13] because of their perceived prohibitive operative risk and relatively short life expectancy. This can be particularly true for CABG. Indeed, as reported in the present study, the 30-day mortality rate after CABG approaches 10%, and this is of clinical significance. The present results, as well as those from a previous study in Finland,[3] showed that the 5-year survival rate can be >70% and did not significantly differ from that of an age-matched general population (73.3%; Statistics Finland).

To the best of our knowledge, the present study is the first to address this important issue by comparing the early and intermediate outcomes after PCI and CABG in octogenarians. In contrast to expectations,[2] in the present series, the early results after PCI were not significantly better than those after CABG, even though the 30-day mortality rate after CABG was somewhat high, because previously reported pooled rates ranged from 6% to 7%.[2,3] We believe our greater rate might have resulted from preoperative selection bias and a local aggressive revascularization policy. The significantly better intermediate survival after CABG in the overall series seemed to be more related to the baseline patient differences than to the treatment modality. A number of patients might have undergone PCI because of a suboptimal functional status. Frailty is a well-recognized factor affecting survival in the elderly in the general population and in patients with acute coronary syndromes or undergoing surgery.[14–16] We were unable to quantify this, because it is not easily discernible from the patient records. It has been previously demonstrated that the assessment of frailty and disability in patients undergoing cardiac surgery risk might improve the discrimination of the operative risk[17]; however, the high rates of false-positive results might diminish their value in clinical decision making.[18,19]

The unadjusted lower survival of patients aged ≥80 years after PCI compared with after CABG seemed to be related to the disproportionately greater risk of the patients undergoing PCI. However, multivariate analysis showed that survival after PCI was similar to that of patients undergoing CABG when adjusted for other important clinical variables. These findings suggest that PCI might likely broaden the benefits of coronary revascularization to patients not fit for CABG.

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