Off-Pump versus On-Pump Coronary Artery Bypass Grafting in the Elderly: A Propensity-Matched Analysis of 387 Patients ≥ 75 Years

J. Börgermann[1,3], O. Kuss[2], K. Hakim[3], R. J. Scheubel[1], A. Simm[1], R.-E. Silber[1], I. Friedrich[1]
[1] Department of Cardiac and Thoracic Surgery, Martin Luther University, Halle-Wittenberg, Halle, Germany
[2] Institute of Medical Epidemiology, Biostatistics, and Informatics, Martin Luther University, Halle-Wittenberg, Halle, Germany
[3] Department of Cardiac and Thoracic Surgery, Friedrich Schiller University Jena, Jena, Germany
e-mail: Jochen.Boergermann@t-online.de

Introduction

Elderly patients are increasingly considered as candidates for coronary artery bypass grafting (CABG) and represent a high-risk group. Off-pump coronary (OPCAB) surgery avoids extracorporeal circulation, global ischemia, and reperfusion of the heart. These factors plus reduced aortic manipulation provide particular benefits for this patient group. Previous evidence (1) from non-randomised studies suggests a lower incidence of death, stroke, and atrial fibrillation in elder patients treated with OPCAB, however, evidence from randomised trials is lacking. A very promising technique for the analysis of non-randomised trials is the so called “propensity score” (PS) method (2,3) , where, in a two-step procedure, a kind of pseudo-randomization can be achieved. This ensures balance of at least the known and measured prognostic factors. Moreover, there are indications that the propensity score method is statistically superior to the standard methods for multivariate adjustment. Therefore, we compared in-hospital outcomes of on-pump (CPB) and off-pump coronary artery bypass grafting in a propensity-matched cohort of patients aged 75 years and above.

Methods

From 2001 to 2007, primary coronary artery bypass grafting was performed in 481 patients (400 on-pump and 81 off-pump) ≥ 75 years of age in a single center. Table 1 gives the distribution of prognostic factors in a propensity-matched sub-cohort of 387 (309 on- pump and 78 off-pump) patients. The PS model was estimated with a standard logistic regression model with all prognostic factors from table 1 included as covariates. Propensity score matching was performed with an optimal matching algorithm. As can be seen, in the PS-matched cohort on- and off-pump patients were remarkably similar with respect to the observed prognostic factors (all p-values > 0.4).

Table 1: Distributions of prognostic factors in the two treatment groups after PS matching. For categorical factors we give absolute and relative frequencies, for continuous factors we give the mean (std, min, median, max) in the respective group. P-values are calculated from standard χ^2-tests (categorical factors) and t-tests (continuous factors).

Prognostic factor	CPB (N=309)	OPCAB (N=78)	p-value
Categorical factors			
Gender male	172 (55.7)	43 (55.1)	0.93
Previous MI			0.99
None	136 (44.0)	35 (44.9)	
<= 30 days	96 (31.1)	24 (30.8)	
> 30 days	77 (24.9)	19 (24.3)	
Diabetes controlled	107(34.6)	28 (35.9)	0.83
Hypertension	303 (98.1)	76 (97.4)	0.73
Priority			0.92
Elective	136 (44.0)	36 (46.2)	
Urgent	112 (36.3)	28 (35.9)	
Emergency	61 (19.7)	14 (17.9)	
Previous stroke	28 (9.1)	8 (10.3)	0.75
COPD	102 (33.0)	26 (33.3)	0.96
Renal insufficiency	60 (19.4)	15 (19.2)	0.97
Instable angina	123 (39.8)	28 (35.9)	0.53
Left main stenosis	96 (31.1)	24 (30.8)	0.96
PVD	74 (24.0)	17 (21.8)	0.69
IABP preoperative	10 (3.2)	4 (5.1)	0.42
Continuous factors			
Age (years)	77.9 (2.6, 75, 77, 91)	78.1 (2.8, 75, 78, 86)	0.62
BMI (kg/m^2)	27.2 (3.6, 18.8, 26.9, 39.6)	27.0 (3.5, 21.2, 26.8, 37.3)	0.63
LVEF (%)	56.8 (16.7, 14, 60, 91)	56.7 (18.0, 14, 60, 88)	0.96

Results

As can be seen from table 2, significant differences were observed in the occurrence of perioperative myocardial infarction (more frequent in off-pump cases, OR [95%-CI]: 4.25 [1.45, 12.51]) and amount of transfused blood (ml) (higher in on-pump cases, difference in means [95%-CI]: 145.7 [8.2, 283.2]. No significant differences were seen in the remaining responses.

Table 2: Results from comparisons of responses in the matched sample. For categorical responses we give absolute and relative frequencies, for continuous responses we give the mean (std) in the respective group. Treatment effects are given as odds ratios and difference in means. P-values are calculated from standard χ^2-tests (categorical responses) and Wilcoxon tests (continuous responses).

Response	CPB (N=309)	OPCAB (N=78)	Effect [95%-CI]	p-value
Categorical responses				
In-hospital mortality	22 (7.1)	4 (5.1)	0.71 [0.24, 2.11]	0.53
Stroke	11 (3.6)	2 (2.6)	0.71 [0.15, 3.28]	0.66
MI	7 (2.3)	7 (9.0)	4.25 [1.45, 12.51]	<0.01
Acute renal failure	26 (8.4)	2 (2.6)	0.29 [0.07, 1.23]	0.07
Prolongued ventilation (>24h)	36 (11.7)	8 (10.3)	0.87 [0.39, 1.95]	0.73
Any major event	58 (18.8)	16 (20.5)	1.12 [0.60, 2.07]	0.73
Re-exploration for bleeding	22 (7.1)	4 (5.1)	0.71 [0.24, 2.11]	0.53
Transitory psychosis	31 (10.0)	8 (10.3)	1.02 [0.45, 2.33]	0.95
Atrial fibrillation	128 (41.4)	33 (42.3)	1.04 [0.63, 1.71]	0.89
Continuous responses				
Postoperative bleeding (ml)	622.1 (484.8)	628.3 (379.5)	-6.2 [-122.2, 109.8]	0.14
Transfusion of RBC (ml)	618.7 (562.3)	473.1 (508.2)	145.7 [8.2, 283.2]	0.02
Total ventilation time (h)	25.1 (51.9)	27.6 (95.3)	-2.4 [-18.1, 13.3]	0.46
Length of stay ICU (h)	90.7(236.6)	92.4 (150.5)	-1.7 [-57.0, 53.7]	0.35
Length of stay hospital (d)	18.0 (10.7)	17.6 (8.4)	0.4 [-2.2, 3.0]	0.94

Conclusion/ Discussion

In elderly patients, isolated CABG can be performed with good clinical results, although mortality remains substantial. The results of our propensity analysis are in agreement with previous studies with respect to in-hospital outcomes in on- and off-pump surgery.

However, the negative effect of the off-pump technique on post-operative myocardial infarctions deserves further investigation. We suspect that a reduced rate of graft patency (4) may be responsible for this. Preserved hemostasis, in off-pump surgery, will promote a procoagulant state with a potentially higher risk of thrombotic events and early bypass occlusion (5). Therefore, an aggressive anticoagulation regimen with acetyl salicylic acid and/or clopidogrel should be considered in off-pump procedures.

We strongly support Panesar et al.‘s (1) claim for a randomized trial for the question under investigation.

References

(1) Panesar SS, Athanasiou T, Nair S, Rao C, Jones C, Nicolaou M, Darzi A. Early outcomes in the elderly: a meta-analysis of 4921 patients undergoing coronary artery bypass grafting-comparison between off-pump and on-pump techniques. Heart. 2006;92:1808-16.
(2) Rosenbaum PR, Rubin DB. The Central Role of the Propensity Score in Observational Studies for Causal Effects. Biometrika. 1983;70:41-55.
(3) Blackstone EH. Comparing apples and oranges. Journal of Thoracic and Cardiovascular Surgery. 2002;123:8-15.
(4) Takagi H, Tanabashi T, Kawai N, Kato T, Umemoto T. Off-pump coronary artery bypass sacrifices graft patency: meta-analysis of randomized trials. Journal of Thoracic and Cardiovascular Surgery. 2007;133:e2-e3.
(5) Mariani MA, Gu YJ, Boonstra PW, Grandjean JG, van Oeveren W, Ebels T. Procoagulant activity after off-pump coronary operation: is the current anticoagulation adequate? Annals of Thoracic Surgery. 1999;67:1370-5.