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Coronary artery bypass grafting in patients with relatively recent previous stent implantation: Three years follow-up results

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Abstract

Background: *An increasing number of patients who undergo coronary artery bypass grafting (CABG) have a history of coronary stent implantation. This study aims to assess perioperative and medium-term follow-up outcomes in patients in whom CABG was preceded by coronary stent implantation within two years before operation.*

Methods: *One hundred and sixty two patients undergoing CABG after previous stent placement (PCI + CABG group) were compared to 149 who had CABG without PCI in the past (CABG group). Clinical, angiographic and perioperative outcome data were compared. The three year follow-up comprised data on number of deaths and the presence of anginal symptoms.*

Results: *In both groups the extent of coronary artery disease was comparable, but more patients in the PCI + CABG group had a history of myocardial infarction. Perioperative outcome data did not differ between the groups except for a higher number of vessels considered infarct-related grafted in the CABG group. Patients operated on up to three months after PCI had more extensive coronary heart disease than those operated on later. They also had a significantly shorter operation time. This group also showed a trend towards less postoperative bleeding, less rethoracotomy and less low cardiac output syndrome. In a three year follow-up, 48 (30%) patients in the PCI + CABG group reported presence of angina compared to 28 (19%) in the CABG group ($p = 0.04$).*

Conclusions: *Previous PCI does not significantly influence the CABG outcome. In medium-term follow-up, freedom from anginal symptoms is less likely in patients in whom CABG was preceded by stent implantation.* (Cardiol J 2009; 16, 4: 312–316)

Key words: coronary bypass grafting, coronary stenting, angina

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Introduction

Widespread use of coronary stenting means that more patients referred for coronary artery bypass grafting (CABG) have a history of previous single or multiple angioplasties. It is not known whether, in patients with coronary stents implanted who finally undergo CABG, the operative outcome is influenced or altered. High risk of in-hospital mortality was attributed to emergency CABG after failed angioplasty [1], to CABG after recent myocardial infarction treated with percutaneous coronary intervention (PCI) [2], and to elective CABG preceded by percutaneous coronary interventions [3, 4]. The Euroscore scale, used for operative risk assessment, encompasses previous cardiac surgery as a risk factor. The history of angioplasty is not included in the scale however [5].

In our study we analyze perioperative outcome and evaluate the in-hospital course of patients with stents implanted in coronary arteries undergoing CABG and assess their status at three year follow-up. We compare this group with patients whose operations were not preceded by PCI.

Methods

This retrospective study included 311 consecutive patients who underwent isolated, first-time CABG between January 2003 and January 2004 in the 2nd Department of Cardiac Surgery of Silesian School of Medicine, Katowice, Poland.

Patients were divided into two groups depending on whether they had previous PCI procedure with stent implantation (PCI + CABG group, n = = 162) or not (CABG group, n = 149). We excluded patients in whom PCI was performed more than two years before CABG and patients with previous CABG and operated on as an emergency. Demographic, cardiac history and perioperative data were retrieved from hospital medical records. Coronary angiography and angioplasty data were obtained from discharge notes. CABG operations were performed via median sternotomy. Antiplatelet therapy was discontinued five days before operation. On initiation of cardio-pulmonary bypass (CPB) heparin in a dose of 3 mg/kg body weight was administered to achieve activated clotting time 600 s. After weaning from CPB, protamin was given in a dose of 3 mg/kg. Coronary angiography and angioplasty procedures were done through femoral arterial access. All stents implanted were bare metal stents.

Three year follow-up was performed by telephone or mail and comprised information on hospitalizations and presence of angina. In cases of failed follow-up contact, data on death was obtained from the state statistical archives.

Additional analysis of angiographic and perioperative outcome data was performed for the PCI + + CABG group with subdivision into patients with stent implantation within three months before operation (S subgroup) and later (L subgroup).

Table 1. Clinical patient characteristics.

	PCI + CABG (n = 162)	CABG (n = 149)	P
Age	64 ± 12	62 ± 8.0	NS
Female	35 (22%)	27 (18%)	NS
BMI [kg/m^2]	27.6	27.3	NS
Hypertension	138 (85%)	122 (82%)	NS
Diabetes	27 (17%)	25 (17%)	NS
Hyperlipidemia	118 (73%)	106 (71%)	NS
Smoking	43 (26%)	61 (41%)	0.01
History of stroke	3 (1.9%)	2 (1.3%)	NS
Peripheral vascular disease	21 (13%)	20 (13%)	NS

PCI — percutaneous coronary intervention; CABG — coronary artery bypass grafting; BMI — body mass index

Statistical analysis

A value of $p(\alpha) < 0.05$ was considered significant. Descriptive statistics were shown for categorical variables as percentages and compared between groups with χ^2 or Fisher exact test. Continuous variables were expressed as mean ± SD and compared between groups with the *t*-Student's test.

Results

There were no significant differences between groups in the demographic data and risk factors, except for smoking which was more common in the CABG group (Table 1). Cardiac history and preoperative angiographic data are presented in Table 2. There were more patients with previous myocardial infarction in the PCI + CABG group. The extent of coronary artery disease did not differ between groups.

PCI procedures were performed between one month and two years before the operation (mean 4.5 months). In 112 patients (69%) stents were implanted in acute coronary syndromes, in 91 (56%) stents were implanted to left anterior descending artery. In 44 cases (27%) two stents were implanted (in 35 patients in separate arteries and in nine patients in one artery). Five patients had two PCI procedures within the two years preceding CABG.

Table 2. Cardiac history and pre-operative angiographic data.

	PCI + CABG (n = 162)	CABG (n = 149)	P
Mean CCS class	2.3 ± 0.7	2.4 ± 0.7	NS
Unstable angina	22 (13%)	31 (20%)	NS
History of MI	130 (80%)	96 (64%)	0.03
LVEF < 30%	8 (5%)	6 (4%)	NS
Euroscore	1.45	1.52	NS
Left main > 50% stenosis	10 (6%)	7 (5%)	NS
3-vessel disease	106 (65%)	105 (70%)	NS
2-vessel disease	41 (25%)	35 (23%)	NS
1-vessel disease (LAD)	5 (3%)	2 (1.3%)	NS

PCI — percutaneous coronary intervention; CABG — coronary artery bypass grafting; CCS — Canadian Cardiovascular Society; MI — myocardial infarction; LVEF — left ventricular ejection fraction; LAD — left anterior descending artery

Indications for CABG were as follows: in the CABG group and among patients in whom angioplasty was performed in an acute coronary syndrome, an indication for surgery was the presence of multivessel disease with significant (> 70%) luminal stenoses, including ten patients with significant (> 50%) left main stenosis. In other patients in the PCI + CABG group, in-stent restenosis was present in two cases and significant multiple *de-novo* stenoses in 38 patients.

Perioperative outcome data did not differ between groups except for a higher number of vessels considered infarct-related grafted in the CABG group (Table 3). There were single cases of stroke and renal failure requiring dialysis in the PCI + CABG group and one in-hospital death in each group, both caused by low cardiac output syndrome. Rethoracotomy was performed on nine patients (5.5%) in the PCI + CABG group and on five (3.3%) patients in the CABG group (p = NS) and was induced by post-operative bleeding in all cases.

Analysis of the PCI + CABG group showed that patients operated upon not long (up to three months) after PCI had more extensive coronary heart disease than those operated upon between three and 24 months after PCI (Table 4). They also had significantly shorter operation times, with non-significantly less grafts/patient implanted. This group also showed a trend towards less post-operative bleeding, less rethoracotomy cases and less low cardiac output syndrome cases.

Three year follow-up was completed in 276 (89%) cases pertaining to information on hospitalizations and presence of angina. Follow-up data applying to death was gathered for all patients

Table 3. Perioperative characteristics.

	PCI + CABG (n = 162)	CABG (n = 149)	P
Off-pump operations	32 (20%)	36 (24%)	NS
Number of grafts/patient	2.6	2,6	NS
Number of arterial grafts	179	170	NS
Number of infarct-related arteries grafted	49 (39%)	76 (82%)	0.001
Extracorporeal circulation time [min]	66 ± 30	66 ± 23	NS
Aortic cross-clamping time [min]	37 ± 14	40 ± 17	NS
Operation time [min]	169 ± 57	161 ± 40	NS
Post-operative:			
Bleeding [mL]	921 ± 517	880 ± 446	NS
Blood transfusion	98 (60%)	85 (57%)	NS
Troponin 24 h post-operatively [ng/mL]	2.24 ± 4.8	2.35 ± 6.6	NS
Rethoracotomy	9 (5.5%)	5 (3.3%)	NS
Low cardiac output syndrome	9 (5.5%)	3 (2%)	NS
Stroke	1 (0.6%)	0	NS
Renal failure requiring hemodialysis	1	0	NS
Cardiac arrest	3 (1.9%)	3 (2%)	NS
Intraaortic balloon pump	9 (5.5%)	5 (3.3%)	NS
In-hospital death	1 (0.6%)	1 (0.7%)	NS

Low cardiac output was diagnosed if cardiac index was < 2 L/min/m^2 and systolic blood pressure < 90 mm Hg in spite of catecholamine treatment. Stroke was diagnosed when clinical symptoms were consistent with the computed tomography scan; PCI — percutaneous coronary intervention; CABG — coronary artery bypass grafting

Table 4. Angiographic and perioperative outcome data within percutaneous coronary intervention (PCI) and coronary artery bypass grafting (CABG) group in division for operated up to three months after stenting (S subgroup) and later (L subgroup).

	S subgroup (n = 130)	L subgroup (n = 32)	P
LM and 3-vessel disease	105 (80%)	18 (56%)	< 0.01
Off-pump operations	26 (20%)	6 (19%)	NS
Number of grafts/patient	2.5	2.7	0.09
Operation time [min]	161 ± 50	178 ± 70	0.03
Post-operative:			
Bleeding [mL]	873 ± 96	983 ± 84	0.08
Rethoracotomy	5 (4%)	6 (19%)	0.09
Low cardiac output syndrome	6 (4.6%)	5 (15.6%)	0.06
Cardiac arrest	2 (1.5%)	2 (6%)	NS
Intraaortic balloon pump	6 (4.6%)	3 (2%)	NS

LM — left main coronary artery diseases

Table 5. Three year follow-up results.

	PCI + CABG (n = 162)	CABG (n = 149)	P
Number of deaths	4 (2.5%)	5 (3.4%)	NS
Number of patients rehospitalized	21 (13%)	15 (10%)	NS
Number of patients with chest pain	48 (30%)	28 (19%)	0.04

PCI — percutaneous coronary intervention; CABG — coronary artery bypass grafting

(for the missing 35 patients, the computer database of the state archives was searched to exclude or confirm death). There were no differences in the number of deaths and the number of patients hospitalized between the PCI + CABG and CABG groups. Significantly more patients reported presence of angina in the PCI + CABG group (Table 5).

Discussion

Patients in both groups (with and without stents in coronary arteries) had a comparable extent of coronary disease and number of grafts implanted (2.6 grafts per patient). There were more cases of grafting an infarct-related artery in the group without previous PCI. This may be due to the fact that in the stent group there was a large proportion of patients in whom myocardial infarction was treated with stent implantation and stented artery did not require further revascularization. Operative time and number of immediate post-operative complications was similar in both groups. Post-operative troponin level was low (between 2 and 3 ng/mL) and there were single cases of low cardiac output syndrome and rethoracotomy (between 2 and 5.5%). The relatively uneventful outcome may be attributed to the low Euroscore count (approximately 1.5) of study group patients. In a recent study by Thielmann et al. [4] on in-hospital outcomes of patients undergoing CABG after previous PCI, it was also found that perioperative outcome was unaffected in patients with a history of one PCI preceding CABG. They found however that patients with multiple previous coronary angioplasties required significantly more frequent intraaortic balloon pump support, cardiopulmonary resuscitation and had major bleeding post-operatively, compared to those without previous PCI or with only one PCI before CABG. As the Euroscore count was not reported, the baseline operative risk can not be estimated and compared with our study. Also in our study the proportion of patients with more than one PCI preceding an operation was small and was not analyzed.

Analysis of the relationship between the time elapsed from stent implantation to operation revealed differences in technical operative aspects with significantly shorter operation time and non-significantly less grafts/patient implanted among those operated within three months of PCI. This may reflect surgeons' preference to limit the procedure in time and extent, based on a subjective conviction that recent stent implantation imposes

an additional hazard on a patient. A trend towards less post-operative bleeding, less rethoracotomy cases and less low cardiac output syndrome cases in this group, compared to those operated upon later after PCI, should be also viewed as a consequence of shorter and limited operation. Duration of CPB correlates with bleeding amount attributed to platelet destruction by CPB [6].

At three year follow-up, there was a single case of death in each group and the number of patients hospitalized did not differ significantly between groups. A significant difference was seen in the number of patients reporting anginal symptoms: 30% in the CABG with former PCI group and 19% in the CABG only group ($p = 0.04$). This finding is similar to observations where PCI preceding CABG was reported to be a strong predictor of post-operative symptom recurrence in 29 ± 11 months observation in a group of 611 patients [7]. In that study, pre-operative PCI was also found to be an independent risk factor for combined adverse cardiac events and increased overall mortality.

The underlying mechanisms leading to symptoms recurrence in cases where an operation was preceded by angioplasty is probably multifactorial. Heart elevation performed during an operation may cause thrombosis at the site of stent placement [8]. Operative maneuvers may cause interactions between vessel wall and stent body similar to that occurring during stent implantation. These take the form of distal embolisation with atheromatous and thrombotic debris, platelet and neutrophil activation, neurohormonal activation and vasoconstriction, oxidative stress and inflamation [9]. Inflammatory response may be also elicted and augmented by cardiopulmonary bypass [10]. All the above may promote in stent restenosis. It was also suggested that the patency rate of the bypass grafts may be compromised by side branch occlusion (either by metal struts or by the so-called snow-plow effect of atheromatous plaque) affecting collateral blood flow [11]. Moreover, as a graft has to be inserted distally to a stent where an artery has smaller diameter, a run-off from a graft may be impaired, eventually causing graft occlusion [4].

Our study's retrospective nature was prompted by the need to assess subjective surgeons' impressions of the increased risk attributed to CABG operations performed after coronary stenting.

The angiographic examination of stented vessels patency was not an element of the follow-up. Its rough estimation may be reflected by the Canadian Cardiovascular Society class assessed at follow-up.

Conclusions

In patients with a history of coronary stent implantation undergoing CABG, the operative outcomes are not significantly influenced by previous PCI. Operative technical aspects may differ in cases when the time from stent implantation to operation is short.

Patients with a history of stent implantation before CABG more often have anginal symptoms in long-term follow up than patients who had only CABG.

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