Kardiovaskuläre Medizin 2008;11:12–15

Influence of drug eluting stents on surgical revascularisation

Franz F. Immer[a], *Sonja Bachmann*[a], *Mario Togni*[b], *Stephan Windecker*[b], *Bernhard Meier*[b], *Thierry P. Carrel* [a]

[a] Department of Cardiovascular Surgery, University Hospital, Berne
[b] Division of Cardiology, University Hospital, Berne, Switzerland

Summary

Introduction: Drug eluting stents (DES) were introduced in clinical routine to reduce neointimal hyperplasia and thus restenosis. Aim of the present study was to analyse the impact of previous PTCA therapy on the clinical outcome of CABG-surgery in a single center experience.
Patients and methods: Data of 411 consecutive patients undergoing isolated CABG-surgery within a 10-months period were analysed. 328 patients (79.8%) were previously treated by the in-house interventional cardiology team. Characteristics of patients with and without previous balloon angioplasty (PTCA) and/or stent were compared.
Results: 72/328 patients (22%) were treated by percutaneous coronary intervention prior to CABG (14 had PTCA only (19.4%), 36 stents without PTCA (50%) and 22 PTCA and stents (30.6%)). Despite use of DES in 53 patients (91.4%), stent failure was found in 29.2% in the interventional treated collective. Patients treated interventionally were younger (63.0 ± 10.0 years vs 66.1 ± 9.7 y; p <0.01) and had a lower incidence of diabetes (12.5% vs 25.8%; p <0.01) in comparison to patients not previously treated by PTCA. They presented with a lower EUROScore (4.0 ± 2.9 vs 5.2 ± 3.7; p <0.01). Perioperative myocardial ischaemia (CK-MB >60 IU/l) was more frequent in the PCI-group than in patients who underwent CABG without previous PCI (12.4% vs 6.3%; p <0.01). One year follow-up revealed no differences between the two groups as far as survival and freedom from reintervention were analysed.
Conclusions: 80% of the patients who received interventional treatment before CABG-surgery presented with a stent. In one third, patients were addressed to surgery, due to stent failure. We observed a higher incidence of perioperative myocardial ischaemia in patients who underwent previous interventional treatment.
Key words: drug eluted stent; outcome; CABG; failure

Introduction

Drug eluting stents (DES) have been introduced in clinical routine. However, in-stent restenosis and stent thrombosis, which have been shown to be more frequent in DES, are still commonly encountered and lead to more serious complications, than those observed in patients, treated with bare-metal stents (BMS) [1]. Subjects who develop in-stent restenosis represent a challenging patient population for both interventional cardiologists and cardiac surgeon [2–4]. In patients with in-stent restenosis the risk of recurrence following repeat percutaneous coronary intervention is increased [3–5]. In patients who undergo CABG-surgery due to in-stent restenosis, graft patency is lower, than in patients without stent failure. In these patients venous grafts have the highest incidence of failure, whereas the use of arterial conduits can improve the angiographic and clinical results [2]. Aim of the present study was to analyse the impact of previous PTCA therapy on the clinical outcome of CABG-surgery in a single center experience.

There is no conflict of interest.

Correspondence:
Franz F. Immer, MD
Department of Cardiovascular Surgery
University Hospital
CH-3010 Berne
Switzerland
E-Mail: franzimmer@yahoo.de

Patients and methods

Data of 411 consecutive patients undergoing isolated CABG-surgery within a 10-months period were analysed. 328 patients (79.8%) were treated by interventional cardiologists and cardiac surgeons in the same institution and were included in the present study. At admission all patients signed an informed consent, which was approved by the local ethical committee. All pre-, intra- and postoperative data were analysed and characteristics of patients with and without previous balloon angioplasty (PTCA) and/or stent (drug eluting stent [DES] / bare metal stent [BMS]) were compared. All coronary angiographies were reviewed and classified according to the extent of CAD, left ventricular function and previous interventional therapy (PTCA and/or stent). The time interval between first angiography and surgery was assessed. If CABG-surgery was found to be indicated by interventional cardiologists following percutaneous coronary intervention (PCI), patients where divided into the following groups of indications: progressive CAD, in-stent restenosis, PTCA-failure (defined as re-occurrence of a stenosis >50% at the site of previous PTCA), delayed complete revascularisation after successful PCI and PCI technically not feasible. Clopidrogel was stopped in elective cases 7 to 10 days previous CABG-surgery.

Statistical analysis

Data were analysed using the StatView 4.1 statistical package (Abacus Concepts, Berkley, CA, USA). Comparing the groups, the Mann-Whitney U and χ^2 test were used for continuous and nominal variables. A p-values less than 0.05 was considered significant.

Results

Seventy-two patients (22%) out of the collective of 328 patients had treatment by PCI prior to CABG. Out of these, 14 patients were treated by PTCA only (19.4%), 36 patients received stents only (50%) and 22 patients had PTCA and stents (30.6%). Despite use of DES in 53 patients (91.4%), stent failure was found in 29.2%. Patients treated by PCI were younger (63.0 ± 10.0 years *vs* 66.1 ± 9.7 y; p <0.01), had a lower incidence of diabetes (12.5% *vs* 25.8%; p <0.01) and history of smoking (15.7% *vs* 27.2%; p <0.01). They presented

Table 1

Pre-, peri- and postoperative data from patients without previous intervention (n = 256) and with previous intervention (n = 72).

	no intervention		intervention		p-value
Nb of patients	256	78.0%	72	22.0%	
Male gender	195	76.2%	58	80.6%	ns
Average age (y)	66.1 ± 9.7		63.0 ± 10.0		<0.05
Risk factors					
Smoking	63	27.2%	15	15.7%	<0.05
Diabetes	65	25.8%	9	12.5%	<0.05
Cholesterol	172	69.9%	52	72.2%	ns
Hypertension	202	80.2%	58	80.6%	ns
Body Mass Index (BMI)	27.3 ± 4.9		27.2 ± 4.1		ns
Preoperative data					
EUROScore	5.2 ± 3.7		4.0 ± 2.9		<0.05
History of MI	109	44.9%	44	62.0%	<0.05
COPD	25	9.9%	5	7.2%	ns
Renal insufficiency	6	2.4%	4	5.6%	ns
Left ventricular EF (%)	54.9 ± 12.1		54.6 ± 10.2		
Intraoperative data					
Nb of distal anastomoses	3.6 ± 1.1		3.4 ± 2.1		ns
Aortic-Cross-Clamping (m)	46.4 ± 15.0		45.8 ± 14.4		ns
Postoperative data					
Mortality (30d)	6	2.3%	0	0.0%	ns
CK-MB >60 iU/l	12	4.7%	7	9.7%	<0.05
Length of stay (d)	6.8 ± 2.1		7.0 ± 2.3		ns
Follow-up					
Survival (1 y)	248	96.8%	70	97.2%	ns
Freedom from reinterv. (1 y)	246	96.1%	69	95.8%	ns

ns = non significant

with a lower EUROScore (4.0 ± 2.9 *vs* 5.2 ± 3.7; p <0.01) (table 1). Perioperative data were similar between both groups, with in average 3.4 ± 1.1 distal anastomoses in the group following PCI and 3.6 ± 1.1 anastomoses in the group without previous PCI (p = ns). Aortic cross clamping time was similar in both groups (p = ns).

Perioperative mortality was 0% in patients with previous PCI, despite EUROScore of 4.0.

Postoperative data revealed a higher incidence of perioperative myocardial ischaemia in patients with previous PCI with 12.4%, in comparison to 6.3% in patients without previous PCI (p <0.05) (table 1). Otherwise no significant differences were found in mortality and the assessed morbidities between the two collectives (table 1). One-year survival was 97.2% in the collective with and 96.8% without preoperative intervention (p = ns). One-year reintervention-free survival was 95.8% in patients with previous intervention, compared to 96.1% in patients with primary CABG.

Discussion

DES were introduced in our institution for clinical use in March 2002. They were heralded as the next breakthrough in the percutaneous treatment of CAD. In fact, it has been shown that DES reduce the incidence of restenosis, compared with BMS [6–8], and may thus reduce the need for repeat revascularisation procedures.

However, a recent study comparing DES versus bilateral internal thoracic grafting (BITA) for multivessel coronary disease in a patient matched control study, showed a better mid-term clinical outcome after surgical revascularisation, with lower rate of angina recurrence and 96% one year reintervention-free survival (Kaplan-Meier) in the BITA-group compared with 86.6% in the Cypher® group (p = 0.005) [9].

The impact of DES on the practice of referral to CABG-surgery has been published recently by Liddicoat and colleagues. They observed a decrease in number of patients referred for CABG-surgery and a significant increase in patients suffering from left main coronary artery disease within the surgical collective [10]. The authors concluded, that this shift can be seen in the context of the revised guidelines of the ACC (The American College of Cardiology) [11], recommending that patients with left main coronary artery disease >50%, should undergo surgical, rather than interventional revascularisation.

In our institution, we could not observe a decrease in patients referred for isolated CABG-surgery. In 2003, 440 isolated CABG-procedures were performed and in 2005 an increase of 34% up to 591 procedures was observed. During the same period, the number of PCIs increased from 1822 in 2003 up to 2061 in 2005 (+13.1%). A similar increase was observed for the use of stents: in 1575 patients in 2003 and in 1814 patients in 2005 (+15.2%), corresponding to a stent rate of 88%.

In our collective, 72 patients (22%) had previous PCI, out of which 58 (80.6%) have been treated with a stent (53 DES [91.4%] *vs* 5 BMS [8.6%]). In 28 patients (38.9%) referral for CABG-surgery was directly related to stent failure: 3 failures of BMS (60%) and 25 failures of DES (47.2%) were documented. It nicely shows, that the failure rate relative to the number of implanted devices during the observation period (91.4% DES) is slightly higher for BMS. This observation is, however, confounded by selection bias.

Stent occlusion, due to stent thrombosis, within the first 30-days after stent implantation, has been shown to be similar in patients treated with DES or BMS and ranges between 1.0% and 1.3% [1, 12]. Thirty-day mortality in these patients has been reported as high as 15%, whereas another 60% suffered a nonfatal myocardial infarction [1]. Restenosis after placement of DES is much less frequent than after BMS, however in a large collective of 1228 patients, restenosis have been observed in 125 patients (10.2%), of which 70 patients (5.7%) required a second target lesion revascularisation [13]. Our results are slightly better, with an incidence of restenosis in the surgical collective with previous PCI of 1.8%. In accordance to the data published by the BARI investigators, the incidence of diabetic patients, treated with DES, was significant lower in the interventional collective than in the CABG-group [14, 15]. Furthermore, mainly sirolimus drug-eluting stents have been used during the observation period at our institution, which seem to be superior to paclitaxel-eluting stents [8, 12, 13], as shown by our group in the prospective SIRTAX data in which 1012 patients were prospectively followed and the need for surgical revascularisation was 1.4% in the DES and 2.8% in the BMS at 2 years follow-up [8].

However, restenosis is mainly found in patients with diabetes, small vessels and complex lesions [13], which may explain the higher

incidence of perioperative ischaemia encountered in these patients, when they undergo CABG-surgery. In fact, patency rate is poor for saphenous vein grafts when used to bypass segments with in-stent restenosis. Arterial conduits have a higher patency rate and should therefore be the first choice in patients with in-stent restenosis [2]. The complexity and severity of CAD in patients with in-stent restenosis, is reflected by a higher number of patients with a perioperative increase of myocardial markers. The incidence of other complications is similar between both groups (p = ns). Despite an EUROScore of 4.0 ± 2.9 in patients undergoing CABG following PCI, 30-day mortality was 0%. One-year survival and one-year reintervention-free survival was similar in both groups.

There are some differences between patients presenting with in-stent restenosis and stent thrombosis. Patients are closely followed after interventional treatment, which allows for early detection of in-stent restenosis and referral to cardiac surgery with preserved left ventricular function. In patients with stent thrombosis however, early mortality and morbidity is high and, if patients have to undergo emergency coronary artery bypass surgery, mortality ranges between 10 to 14% [16].

Limitation

This is a report from a single center. However, this study reflects routine clinical practice. This study does not allow any conclusion on safety of DES.

Conclusions

Good selection of patients, suitable for interventional therapy, may reduce the incidence of adverse events and improve outcome in patients with CHD. Despite the development of DES, in-stent restenosis and stent thrombosis still rarely complicate the clinical course following PCI necessitating CABG in selected patients. Patients with previous PCI and stent failure must be revascularised, whenever possible, with arterial grafts.

References

1 Ong AT, Hoye A, Aoki J, van Mieghem CA, Rodriguez Granillo GA, Sonnenschein K, Regar E, McFadden EP, Sianos G, van der Giessen WJ, de Jaegere PP, de Feyter P, van Domburg RT, Serruys PW. Thirty-day incidence and six-month clinical outcome of thrombotic stent occlusion after bare-metal, sirlolimus, or paclitaxel stent implantation. J Am Coll Cardiol 2005;45(6):947–53.

2 Gaudino M, Cellini C, Pragliola C, Trani C, Burzotta F, Schiavoni G, Nasso G, Possati G. Arterial versus venous bypass grafts in patientswith in-stent restenosis. Circulation 2005;112:I-265–I-269.

3 Alfonso F, Zueco J, Cequier A, Mantella R, Bethencourt A, Lopez-Minguez JR, Angel J, Auge JM, Gomez-Recio M, Moris C, Seabra-Gomes R, Perez-Vizcayno MJ, Macaya C. Restenosis intra-stent: Balloon angioplasty versus elective stentino (RIBS) Investigators: A randomized comparison of repeat stenting with balloon angioplasty in patients with in-stent stenosis. J Am Coll Cardiol 2003;42:796–805.

4 Alfonso F, Cequier A, Zueco J, Moris C, Suarez CP, Colman T, Esplugas E, Perez-Vizcayno MJ, Fernandez C, Macaya C. Stenting the Stent: initial results and long-term clinical and angiographic outcome of coronary stenting for patients with in-stent restenosis. Am J Cardiol 2000;65:327–32.

5 Mehran R, Dangas G, Abizaid A, Lansky AJ, Mintz GS, Pichard AD, Satler LF, Kent KM, Waksman R, Stone GW, Leon MB. Treatment of focal in-stent restenosis with balloon angioplasty alone versus stenting: short- and long-term results. Am Heart J 2001;141:610–614.

6 Moses JW, Leon MB, Fitzgerald PJ, et al. for the SERIUS Investigators. Sirolimus-eluting stents versus standard stents in patients with stenosis in native coronary artery. N Engl J Med 2003;349:1315–23.

7 Stone GW, Ellis SG, Cox DA, et al. for the TAXUS-IV Investigators. One year clinical results with the slow-release, polymer-based, paclitaxel-eluting TAXUS stent: the TAXUS IV trial. Circulation 2004;109:1942–7.

8 Windecker S, Remondino A, Eberli FR, et al. Sirolimus-eluting and paclitaxel-eluting stents for coronary revascularization. N Engl J Med 2005;353(7):653–62.

9 Herz I, Moshkovitz Y, Loberman D, Uretzky G, Braunstein R, handler A, Zivi E, Ben-Gal Y, Mohr R. Drug-eluting stents versus bilateral internal thoracic grafting for multivessel coronary disease. Ann Thorac Surg 2005;80(6):2086–90.

10 Liddicoat JR, De la Torre R, Ho, KLK, Nathan S, Levitsky S, Krempin J, Selke F. Initial impact of Drug-Eluting Stents on Coronary artery bypass graft surgery. Ann of Thorac Surg 2006;81:1239–42.

11 Eagle KA, Guyton RA, Davidoff R, et al. ACC/AHA 2004 guideline update for coronary artery bypass graft surgery: summary article. Circulation 2004;110:1168–76.

12 Iakovu I, Schmidt T, Bonizzoni E, Ge L, Sangiorgi GM, Stankovic G, Airoldi F, Chieffo A, Montorfano M, Carlino M, Michev I, Corvaja N, Briguori C, Gerckens U, Grube E, Colombo A. Incidence, predictors, and outcome of thrombosis after successful implantation of drug-eluting stents. JAMA 2005;293(17):2126–30.

13 Lee CW, Park DW, Lee BK, Kim Yh, Hong MK, Kim JJ, Park SW, Park SJ. Predictors of restenosis after placement of drug-eluting stents in oneor more coronary arteries. Am J Cardiol 2006;97(4):506–11.

14 Comparison of coronary bypass surgery with angioplasty in patients with multivessel disease. The Bypass Angioplasty Revascularization Investigation (BARI) Investigators. N Engl J Med 1996;335:217–25.

15 Influence of diabetes on 5–year mortality and morbidity in a randomized trial comparing CABG and PTCA in patients with multivessel disease: the Bypass Angioplasty Revascularization Investigation (BARI). Circulation 1997;96(6): 1761–9.

16 Yang EH, Gumina RJ, Lennon RJ, Holmes DR Jr, Rihal CS, Singh M. Emergency coronary artery bypass surgery for percutaneous coronary interventions: changes in the incidence, clinical characteristics, and indications from 1979 to 2003. J Am Coll Cardiol 2005;46(11):2010–2.