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Long-Term Clinical Outcome After Stent Implantation in Saphenous Vein Grafts

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Objectives. **We sought to determine the role of stent implantation in vein grafts by evaluating the long-term clinical outcome and estimated event-free survival at 5 years in 62 patients and by comparing our data with those of other treatment modalities previously reported.**

Background. **Patients with recurrent angina after coronary artery bypass graft surgery pose a problem. Stent implantation has been advocated in an effort to avoid repeat operation and to address the limitations of balloon angioplasty.**

Methods. **Patients undergoing stenting of a vein graft were entered into a dedicated data base. They were screened for death, infarction, bypass surgery and repeat angioplasty. Procedure-related events were included in the follow-up analysis. Survival and event-free survival curves were constructed by the Kaplan-Meier method.**

Results. **A total of 93 stents (84 Wallstent and 9 Palmaz-Schatz) were implanted in 62 patients. During the in-hospital period, seven patients (11%) sustained a major cardiac event: two deaths (3%), two myocardial infarctions (3%) and three urgent bypass surgeries (5%). The clinical success rate, therefore, was 89%. During the follow-up period (median 2.5 years, range 0 to 5.9), another five patients (8%) died, 14 (23%) sustained a myocardial infarction, 12 (20%) underwent bypass surgery, and 14 (23%) underwent angioplasty. The estimated 5-year survival and event-free survival rates (free from infarction, repeat surgery and repeat angioplasty) were (mean ± SD) 83 ± 5% (95% confidence interval [CI] 73% to 93%) and 30 ± 7% (95% CI 16% to 44%), respectively.**

Conclusions. **The in-hospital outcome of patients who underwent stent implantation in a vein graft is acceptable, but the long-term clinical outcome is poor. It is unlikely that mechanical intervention alone will provide a satisfactory or definite answer for the patient with graft sclerosis over the long term.**

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Coronary artery bypass graft surgery effectively relieves angina in patients with obstructive coronary artery disease and may prolong life in a selected group of patients (1,2). Recurrence of angina, however, occurs in 5% to 10% of patients each year and is mainly due to graft failure or a combination of graft failure and progression of coronary atherosclerosis (3–5). Serial angiographic studies revealed that 15% to 30% of the grafts are stenosed at 1 year after surgery and that nearly 50% of the grafts are closed at 10 years after surgery (6–8).

As the number of patients who undergo surgery increases, the number of patients with recurrent angina due to graft failure will also increase (9,10). Optimal management of these patients remains a subject of debate. In addition to pharmacologic treatment, other therapeutic options are repeat surgery or percutaneous revascularization. In general, repeat surgery is associated with an increased morbidity and mortality and less symptomatic relief in comparison to a first operation (10–12).

Balloon angioplasty of vein grafts may successfully be performed in selected patients but is plagued by a high restenosis rate (3). Patients with old, diffusely diseased or totally occluded grafts are at an increased risk of major cardiac complications owing to the risk of embolization of friable graft tissue into the coronary circulation (3). As a result, the use of stents is advocated to treat such patients. This is not only based on the fact that stents can be easily implanted in large vessels and may contain friable graft tissue and thus reduce the risk of embolization, but also on the assumption that the superior angiographic outcome immediately after implantation will be translated into a superior long-term clinical outcome (13,14). Clinical benefit, however, is largely based on anecdotal experience and a number of case studies with special emphasis on technical success rates and short-term rather than long-term clinical outcome. Randomized clinical trials are now under way to address this issue (15). They may, however, fail to give a definite answer owing to stringent inclusion and exclusion criteria. To reinforce the debate on the role of stent implantation in vein grafts and while awaiting the results of randomized trials, we report the immediate and long-term clinical outcome in a series of 62 patients who underwent stent implantation in a vein graft. All patients gave written informed

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Table 1. Baseline Clinical and Angiographic Characteristics of 62 Study Patients

Median age (yr)	65
Range	43–78
Men	52 (84%)
Previous AMI	37 (60%)
Previous PTCA	17 (27%)
Risk factors	
Smoking	12 (19%)
Hypercholesterolemia	32 (52%)
Hypertension	17 (27%)
Diabetes	7 (11%)
NYHA functional class	
I	2 (3%)
II	7 (11%)
III	31 (50%)
IV	22 (36%)
Vessel disease	
1	1 (2%)
2	12 (19%)
3	49 (79%)
Ejection fraction	
>50%	17 (27%)
>30–50%	40 (65%)
≤30%	3 (5%)
Unknown	2 (3%)
Angiographic indication	
Primary lesion	51 (82%)
Restenosis	8 (13%)
Rescue angioplasty	3 (5%)
Median graft age (yr)	7.7
Range	1–20

Unless otherwise indicated, data presented are number (%) of patients. AMI = acute myocardial infarction; NYHA = New York Heart Association; PTCA = percutaneous transluminal coronary angioplasty.

consent before stent implantation, and the study was approved by the Medical Ethical Committee of our institution.

Methods

Patients. Between November 1986 and June 1994, 62 patients underwent stent implantation in a vein graft. They constitute 1.2% of the 5,340 patients who underwent coronary angioplasty in our institution during the same period. Baseline clinical and angiographic characteristics are shown in Table 1. The majority of patients underwent stent implantation because of severe angina pectoris (New York Heart Association [NYHA] classes III and IV, 86%) and as a treatment for a de novo graft lesion (82%). Most of the grafts were old (median age 7.7 years) and were, in general, diffusely diseased, as shown in Figure 1. Detailed baseline angiographic data were available in 57 patients and are shown in Table 2.

Stent implantation. Stent implantation was performed by standard techniques using the femoral approach, as previously described (16). The target lesion was first dilated with a balloon catheter to facilitate stent delivery. At variance with current standards of stent implantation, additional balloon dilation after stenting was performed in only 44 patients (71%). This was done with semicompliant balloons equal in size to or 0.5 mm larger than the interpolated reference diameter of the bypass graft (on-line quantitative coronary angiographic measurement) and by using pressures ranging from 10 to 14 atm. The total number, type and size of stents implanted are shown in Table 2. In almost all patients (90%) a Wallstent was used.

The postoperative treatment changed throughout the study period. While all patients were treated with a combination of acetylsalicylic acid, dipyridamole, heparin and acenocoumarol immediately after implantation, the first 26 patients also received 100,000 to 250,000 U of intravenous urokinase, which was infused through the guiding catheter into the vein graft. Thrombolytic therapy was later withheld from the postoperative treatment because of a high frequency of major bleeding complications, particularly at the vascular access site.

Stent implantation was regarded to be angiographically successful when there was no residual stenosis within the stented segment by visual assessment. A clinically successful stent implantation was defined as an angiographically successful implantation free of procedure-related complications leading to death, myocardial infarction, bypass surgery or repeat

Figure 1. Angiographic result immediately after implantation of three Palmaz-Schatz stents in a graft supplying the left anterior descending coronary artery.

Table 2. Stent Implantation and Quantitative and Qualitative Angiographic Data

Stent data	
Total no. of stents	93 (100%)
No. of stents/patient	1.5
Wallstent	84 (90%)
Palmaz-Schatz stent	9 (10%)
Nominal size	
3.0	5 (5%)
3.5	25 (27%)
4.0	38 (41%)
4.5	14 (15%)
5.0	8 (7%)
5.5	1 (1%)
6.0	2 (2%)
Quantitative angiographic data (57 pts)	
Reference diameter (mm)	
Before stenting	3.3 ± 1.8
After stenting	3.5 ± 1.5
Minimal lumen diameter (mm)	
Before stenting	1.4 ± 0.5
After stenting	2.7 ± 3.1
Diameter stenosis (%)	
Before stenting	58 ± 20
After stenting	23 ± 9
Lesion length (mm)	
Before stenting	16.5 ± 8.3
After stenting	—
Qualitative angiographic data (62 pts)	
Chronically occluded grafts	0 (0)
Presence of thrombus	3 (1%)
Long lesions (>15 mm)	32 (52%)
Tandem lesions	23 (37%)
Lesion containing ulcus	25 (40%)

Data presented are mean value ± SD or number (%) of patients (pts).

angioplasty. A periprocedural infarction was determined by the development of new Q waves or an increase in the serum cardiac enzymes to more than twice the upper limit of normal.

Data collection and follow-up. Procedural details, including complications, were prospectively entered into a dedicated data base at the time of implantation. Procedure-related events were included in the follow-up analyses. All patients who survived their hospital stay were checked against the civil registry to establish survival or death. Patients were screened for the occurrence of death, acute myocardial infarction, recurrent angina necessitating repeat percutaneous revascularization or repeat bypass surgery. Clinical follow-up information was obtained retrospectively through an interview during outpatient clinic visits or from the patient or family by telephone or from the referring physician. Two patients were lost to follow-up. As a result, follow-up was complete for 60 patients (98%). The median period of follow-up was 2.5 years (range 0 to 5.9). Patient survival curves and event-free plots were constructed by the Kaplan-Meier method. Repeat angiography 6 months after stent implantation was performed in only 43 patients (69%).

Results

In-hospital outcome. A total of 93 stents were implanted (Table 2). In one patient, stent implantation was unsuccessful. Therefore, the implantation or angiographic success rate was 98%. In seven patients, a total of nine major cardiac events occurred during the hospital period (Table 3). As a result, the overall clinical success rate was 89%. Two patients (3.2%) died after stent implantation. Both of them received thrombolytic therapy—one patient because of protocol requirements during the initial study period and the other patient because of an acute myocardial infarction that was treated with balloon angioplasty and subsequent stent implantation, in addition to thrombolysis. In this patient, embolization of the graft material was noted during the procedure, which resulted in a creatine kinase (CK) elevation to 640 U/liter. A computed tomographic scan confirmed intracranial hemorrhage in both patients. Two other patients (3.2%) developed an acute myocardial infarction during their hospital stay, with a CK elevation to 706 and 1,100 IU/liter. One of these two patients was admitted because of an acute inferior infarction and was treated with balloon angioplasty and stent implantation into the graft supplying the right coronary artery. The other patient developed an anterolateral infarction with a CK elevation to 706 IU/liter 4 days after stent implantation. Although the infarction was mainly caused by a subacute stent thrombosis, the exact cause was not documented. Another three patients (4.8%) were referred for

Table 3. Major Cardiac Events During Hospital Stay and After Discharge

	In-Hospital (n = 62)		After Discharge (n = 60)*		Total (n = 62)	
	Total	Ranking	Total	Ranking	Total	Ranking
Event						
Death	2 (3%)	2 (3%)	5 (8%)	5 (8%)	7 (11%)	7 (11%)
AMI	3 (5%)	2 (3%)	14 (23%)	14 (23%)	17 (27%)	16 (26%)
CABG	3 (5%)	3 (5%)	12 (20%)	12 (20%)	15 (24%)	15 (24%)
Re-PTCA	1 (2%)	0	18 (30%)	14 (23%)	19 (31%)	14 (23%)
Total	9 (15%)	7 (11%)	49 (82%)	45 (75%)	58 (94%)	52 (84%)

*Two patients lost to follow-up. Data presented are number (%) of patients. Ranking = frequency of events in descending order of severity (death [worst outcome], followed in order of rank by acute myocardial infarction [AMI], bypass surgery [CABG], repeat intervention [Re-PTCA]). Total = total count of all events (nonmutually exclusive analysis).

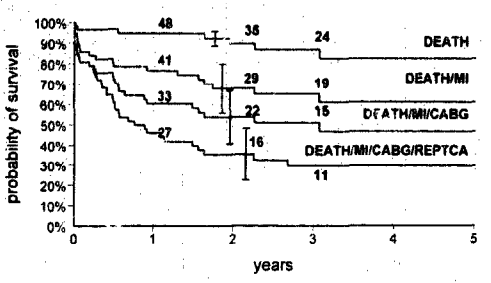

Figure 2. Survival and event-free survival curves (Kaplan-Meier) of patients who underwent stent implantation in a vein graft. CABG = coronary artery bypass graft surgery; MI = myocardial infarction; REPTCA = repeat percutaneous transluminal coronary angioplasty.

urgent bypass surgery; one patient because of recurrent angina 11 days after stent implantation and two other patients because of a documented subacute stent thrombosis. In one of these two patients, anticoagulation was stopped because of gastrointestinal bleeding (Mallory-Weiss syndrome).

In addition, a major bleeding complication necessitating blood transfusion occurred in six patients (9.8%)—two groin (3.2%), three gastrointestinal (4.8%), one retroperitoneal (1.6%)—and a vascular access site complication necessitating surgery or blood transfusion, or both, in another eight patients (12.9%). The median hospital stay for the total study cohort was 9 days (range 5 to 53).

Clinical events after hospital discharge. Table 3 lists the occurrence of major events after hospital discharge. There were five deaths (8%), two of which were cardiac, one noncardiac and two of unknown etiology. Fourteen patients (23%) sustained a nonfatal myocardial infarction. In 2 of these 14 patients, myocardial infarction was associated with a repeat balloon angioplasty during the follow-up period. Twelve patients (20%) underwent repeat bypass surgery at a median interval of 7 months (range 1 to 43). In all but one of these patients, the indication of repeat surgery was angina pectoris in association with restenosis of the stented graft segment. Repeat angioplasty was performed in 18 other patients (30%) at a medium interval of 6 months (range 1 to 32). As for the patients who underwent repeat bypass surgery, in all but one, the angiographic indication to perform angioplasty was restenosis in or adjacent to the stented graft segment. Repeat angioplasty was successful in 16 patients but was complicated by a myocardial infarction in two. Repeat angiography 6 months after stent implantation was performed in 43 patients (69%). Restenosis (50% diameter stenosis criterion) was documented in 23 patients (53%), 7 of whom underwent repeat angioplasty and 6 bypass surgery. During the further follow-up, another seven and six patients underwent repeat angioplasty and bypass surgery, respectively, because of graft failure at the stented site in all but two patients.

Survival and event-free survival. The mean ± SD estimated survival at 5 years after stent implantation was 83 ± 5% (95% confidence interval [CI] 73% to 93%) (Fig. 2). Survival free from myocardial infarction at 5 years was 61 ± 6% (95% CI 49% to 73%) and event-free survival at 5 years free from myocardial infarction, bypass surgery and angioplasty was 30 ± 7% (95% CI 16% to 44%).

Discussion

The present study describes the immediate and long-term clinical outcome of 62 patients with angina pectoris who underwent stent implantation in a vein graft. The angiographic indication was a de novo lesion in the majority of patients (82%) and a restenotic lesion in 13%. Taking into account the limitations of this study—on the one hand, the design and therefore the potential shortcomings in the accuracy of data collection, and on the other hand, the fact that it concerns a series of nonconsecutive patients with, in general, advanced graft failure—the main message of the present study is that stent implantation in vein grafts can be safely performed but that the long-term clinical outcome is poor. This should be interpreted when taking into account that in the majority of patients a Wallstent was implanted and that high pressure balloon dilations according to current standards were not performed. Changes in stent design and, especially, implantation and deployment technique may have beneficially influenced early and late outcomes (13,15).

In-hospital results. With respect to safety, the frequency of in-hospital events is acceptable despite advancing graft age and the complications one could anticipate from such a graft based on the underlying histopathologic substrate described by Sabre et al. (17). The reported frequency of in-hospital events compares favorably with that after balloon angioplasty of vein graft lesions and with that after repeat bypass surgery (Tables 4 and 5) (18–50). It is, however, inferior to the frequency after stent implantation in vein grafts reported by other investigators (51–63) (Table 6). Again, one should account for the type of patients treated in this study. In most other reported studies shown in Table 6, 70% to 80% of the patients had a discrete lesion <10 to 13 mm long; thus, they may represent a more favorable group of patients. Furthermore, it should be recognized that two patients died because of an intracranial hemorrhage after thrombolytic therapy, and that two other patients received a stent in the setting of an acute myocardial infarction. Fine tuning of the indication for stent implantation and of the periprocedural and postprocedural pharmacologic treatment by systemic use of high pressure balloon dilations may have resulted in a better immediate outcome. It is noteworthy that despite the above observations, the frequency of in-hospital major cardiac events compares favorably with that after stent implantation in coronary arteries. The reported frequencies of death, acute myocardial infarction and emergency bypass surgery in 1,191 patients treated with a stent in a coronary artery between 1989 and 1992 were 2.0, 3.3 and 1.9%, respectively (64).

Long-term results. The long-term clinical outcome is disturbing. This is not so much because of the estimated 5-year survival rates, which was 83% in this study. The long-term

Table 4. In-Hospital Events After Balloon Angioplasty of Saphenous Vein Grafts

Study									
First Author	Year	Ref. No.	Study Period	No. of Pts	Age (yr)	Graft Age (yr)	Death (%)	AMI (%)	CABG (%)
Ford	1981	18	1978–1979		51	0.3 to 4.7	0	0	0
Jones	1983	19	1978–1982	37	54	2	0	5	5
Douglas	1983	20	1978–1992	62	54	<1 to >5	0	0	2
El-Gamal	1984	21	1980–1982	31	NR	0.3 to 4.7	0	5	0
Block	1984	22	1979–1982	44	56	0.2 to 9	0	0	2
Corbelli	1985	23	1981–1984	35	51	<0.5 to >5	0	0	2
Reeder	1986	24	1979–1984	19	60	3	5	5	10
Cote	1987	25	1981–1985	82	60	4	0	4	1
Ernst	1987	26	1980–1985	33	59	NR	0	6	0
Dorros	1988	27	1979–1986	53	58	7	4	1	1
Reed	1989	28	1983–1986	54	58	3	0	0	0
Platko	1989	29	1981–1987	101	60	4	2	6	2
Webb	1990	30	1978–1988	140	NR	NR	0	4	1
Jost	1991	31	1978–1983	41	57	3	0	0	0
Reeves	1991	32	1981–1987	57	58	5	2	9	2
Plokker	1991	33	1980–1989	454	60	6	1	3	1
Meester	1991	34	1981–1988	84	60	5	4	8	2
White	1993	35	NR	21	65	10	0	0	0
Morrison	1994	36	1986–1993	75	62	8	3	3	1
Total/weighted average				1,408			1	6	2

NR = not reported; Ref = reference; other abbreviations as in Tables 1 to 3.

survival does not differ from the 5-year survival in patients who underwent balloon angioplasty of a vein graft lesion or who underwent repeat bypass surgery, which have been reported to vary between 70% and 89% and 76% and 94%, respectively (65–67) (Table 7). Rather, it is mainly because of a high incidence of myocardial infarction and a very strong need for repeat revascularization during the follow-up period. Almost 25% of the patients sustained an acute myocardial infarction at a median of 6 months (range 1 to 21) after the index procedure, and almost 50% of the patients underwent repeat revascularization by means of either repeat bypass surgery (22%) or repeat angioplasty (23%) at a median of 7 (range 1 to 43) and 6 (range 1 to 32) months, respectively. In all these patients, apart from two, the indication for repeat revascular-

Table 5. In-Hospital Events After Repeat Bypass Surgery

Study										
First Author	Year	Ref. No.	Study Period	No. of Pts	Age (yr)	Graft Age (yr)	Death (%)	AMI (%)	Rethoracotomy (%)	Other (%)
Norwood	1977	37	1970–1975	26	49	0.5	8	12	NR	NR
Reul	1979	38	1968–1978	168	51	NR	5	2	2	≥2
Schaff	1983	39	1969–1980	106	49	NR	3	8	NR	11
Foster	1984	11	1976–1979	283	52	3	5	6	5	5
Cameron	1988	40	1970–1973	64	58	8	5	NR	NR	NR
Brenowitz	1988	41	1973–1986	150	56	8	12	5	7	23
Osaka	1988	42	1970–1983	119	52	4	3	9	3	3
Verkkala	1989	43	1970–1988	71	54	4	10	NR	NR	NR
Nair	1989	44	1980–1986	73	51	3	4	NR	NR	NR
Loop	1990	45	1967–1987	2,509	57	6	4	7	8	9
Verheul	1991	46	1979–1987	200	58	5	8	4	6	7
Galbut	1991	47	1982–1988	88	62	9	7	8	6	21
Akl	1992	48	1981–1990	115	54	0.5	5	4	NR	7
Horton	1992	49	1981–1990	172	59	3–7	1	0	2	NR
Noyez	1994	50	1987–1992	16	50	11	0	3	13	13
Total/weighted average				4,160			5	6	7	9

Other = total sum of reported complications, such as cerebrovascular accidents, pulmonary and renal failure, bleeding and wound infection; other abbreviations as in Tables 1, 2 and 4.

Table 6. In-Hospital Events After Stent Implantation in Saphenous Vein Grafts

Study First Author	Year	Ref. No.	Study Period	No. of Pts	Age (yr)	Graft Age (yr)	No. of Stents	Death (%)	AMI (%)	CABG (%)	PTCA (%)	Bleeding/ Vasc (%)
Urban	1989	51	1986–1988	13	63	5	20	0	0	0	NR	15
de Scheerder	1992	52	1988–1990	69	63	7	136	4	7	6	3	33
Strumpf	1992	53	1990–1991	26	68	9	30	0	4	0	4	19
Pomerantz	1992	54	1988–1991	69	66	9	84	0	10	0	NR	7
White	1993	55	NR	11	64	NR	16	0	0	0	0	0
Wong	1994	56	1990–1992	589	66	9	NR	2	0.3	1	NR	16
Eeckhout	1994	57	1986–1993	40	63	8	58	0	2	2	NR	14
Fenton	1994	58	1990–1991	198	66	8	NR	0.5	0.5	0.5	0.5	26
Nordrehaug	1994	59	NR	19	60	NR	NR	0	11	0	6	16
Keane	1994	60	1991–1993	29	63	10	35	0	0	0	0	17
Piana	1994	61	1988–1993	150	66	9	200	1	0	0	0	27
Rocha-Sing	1995	62	1989–1992	22	66	NR	NR	5	0	0	0	<7
Wong	1995	63	1990–1991	231	66	8	305	1	1	0.4	0.4	1
Total/weighted average				1,466				1	1	1	1	16
Present Study			1993–1994	62	65	8	93	3	5	5	1	23

Vasc = vascular complications; other abbreviations as in Tables 1 to 4.

ization was failure of the graft at the site of the stented segment. As mentioned above, the use of high pressure balloon dilation after stenting may have resulted in a lower restenosis rate and, consequently, less need for subsequent revascularization.

Yet, although half of the major cardiac events occurred within the first 6 months after stent implantation, these data and the configuration of the Kaplan-Meier plots indicate a continuous and progressive clinical deterioration beyond this period. Given the limitations of comparing those data with other studies reported to date, the 1- and 5-year survival rates do not differ between the various treatment modalities for recurrence of angina due to graft failure (Table 7). The 5-year event-free survival, however, appears to be significantly inferior after balloon angioplasty or stent implantation when compared with repeat surgery. This is largely based on the stronger need of repeat revascularization after catheter-based interventions. It is, however, important to point out that the decision to proceed with another revascularization is not only patient but also physician related. The threshold for performing a third or fourth repeat bypass operation is obviously much higher than for another angioplasty. If repeat surgery and angioplasty are excluded from the survival analysis, the 5-year survival free from myocardial infarction is 61 ± 6% (95% CI 49% to 73%). Nevertheless, patients who have had previous bypass surgery represent a select and difficult-to-manage subgroup of patients with ischemic heart disease. This is illustrated by the work of Lytle et al. from The Cleveland Clinic Foundation (68). They found that patients who have had previous bypass surgery do less well in terms of survival and event-free survival, irrespective of the presence or absence of graft stenoses, in comparison with patients with obstructive coronary artery disease but without a previous bypass operation. Furthermore, it needs to be emphasized that the prognosis of patients who have had previous bypass surgery is determined not only by the extent of coronary artery disease and the degree of graft failure but also by other clinical and anatomic factors such as age, coexisting disorders, ventricular function and type of conduit used. Furthermore, it is noteworthy that the Cholesterol Lowering Atherosclerosis Study, in which male patients who have had previous bypass surgery were randomized into a placebo group and a group receiving lipid-modifying drugs, revealed a significantly lower rate of progression and a significantly higher rate of regression in the active

Table 7. Survival and Event-Free Survival After Balloon Angioplasty, Repeat Surgery or Stent Implantation in Saphenous Vein Grafts

	Survival				Event-Free Survival			
Treatment	Ref. No.	No. of Pts	1 Year (%)	5 Years (%)	Ref. No.	No. of Pts	1 Year (%)	5 Years (%)
Balloon angioplasty	27, 29, 30, 33, 34, 66	915	90–94	70–89	33, 34, 66	621	50–60	26
Repeat surgery	39–42, 65	1,939	—	76–94	65, 67	2,000	—	63–76
Stent implantation	54, 61	219	90–91	—	54, 56, 58, 61	1,006	56–86	—
Present study		62	95	83		62	46	30

— = not available.

treatment group (39% vs. 61% and 16% vs. 2.4%, respectively) (69). Therefore, risk factor modification may play a role in the improvement of the late outcome.

Study limitations. A number of limitations have been briefly mentioned above. In addition to the design, the major drawback of the present study is that the patient group does not comprise a series of consecutive patients. Therefore, the possibility of an important selection bias cannot be neglected. In addition, we have basically reserved stent implantation for patients with advanced graft failure. This is not only because of our own philosophy with respect to the management of these patients but also because our center is a tertiary referral center. Forty-three percent of the patients are referred because of this top referral function. The small number of patients did not allow us to stratify patients into subgroups to explore which patient may benefit more from this treatment than the other. Therefore, we are unable to give guidelines with respect to improvement in patient selection and indications. In addition, the results reported herein need to be challenged by other investigators with larger series and, if possible, consecutive patients. Learning curve, more strict indications, improvements in stent design, changes in periprocedural procedures such as in-stent high pressure balloon dilations, which affect not only the postprocedural pharmacologic treatment but also potentially the clinical outcome, and, finally, more attention to risk factor modifications may contribute to superior results.

Conclusions. The management of patients with recurrent angina and graft failure is complex. In this historical series of nonconsecutive patients, in which the self-expanding Wallstent was predominantly used according to previous standards of stenting, stent implantation was associated with a poor long-term clinical outcome. These observations needs to be challenged by more recent studies. It may well be that changes in stent design and the systematic use of in-stent high pressure balloon dilations may result in a better long-term outcome. In addition, attention needs to be paid to risk factor modification to reduce long-term graft failure.

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