Original Article

Clinical Meaning of Uncomplicated Coronary Dissections After Stent Implantation

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Objective

To assess the influence of uncomplicated coronary dissections in the incidence of target vessel revascularization and cardiovascular events after 1 year.

Methods

Patients treated from June 1996 to December 2000, with data prospectively collected and uncomplicated dissections (G1, n=36), were compared with those patients without dissections (G2, n=871). Data were assessed with SPSS 8.0 statistical software, the outcomes were compared with the Kaplan-Meier curve, and the significance level was assessed using the log-rank test.

Results

Clinical features were similar in both groups: G1 had lower mean reference diameters (P<0.0001), a greater number of patients with type C lesions (P=0.01), a lower final lumen diameter at the end of the procedure (P=0.003), and a greater balloon/artery ratio (P<0.0001). In the multivariate analysis, only the reference diameter and the artery/balloon ratio were independently associated with the presence of residual dissections. No statistically significant difference existed in the incidence of revascularization of the target vessel and major cardiovascular events, at 1-year clinical follow-up, between the 2 groups of patients. Predictors of adverse clinical events at 1 year were the reference diameter, lesion extension, and residual stenosis, rather than the presence of residual dissection.

Conclusion

Uncomplicated residual dissections after coronary stents are associated with narrower vessels and a higher balloon/artery ratio. Residual dissections are not associated with worse outcomes at 1-year clinical follow-up.

Key words

hemodynamic, stents, dissection

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Angiographically visible dissections occur in 30% of cases after balloon coronary angioplasty [1-3] and in 5 to 10% of patients when the procedure involves stent implantation [4]. These dissections may be extensive and complicated, with contrast retention rapidly evolving to occlusion of the treated vessel, or they can be limited, without contrast retention and flow compromise [5-8]. Cutlip et al [9] demonstrated that dissections, even the uncomplicated ones, are one of the main predictors of subacute thrombosis following stent implantation. These residual dissections are generally treated with a second stent, but the total length of the implanted stent is also associated with a greater risk of adverse events [9] and is consistently reported as one of the factors most strongly associated with restenosis [10-12].

The studies [13-15] that analyzed the influence of uncomplicated residual dissections after coronary angioplasty in long-term follow-up do not suggest that a greater risk of restenosis exists in these patients. On the other hand, late follow-up of patients with uncomplicated coronary dissections after stent implantation is rarely studied [16,17]. Thus, the objective of this study was to assess the influence of uncomplicated residual dissections after coronary stent implantation in the incidence of major cardiovascular events after 1 year.

Methods

The patients in this study had symptomatic ischemic heart disease and were treated with coronary stent implantation, from June 1996 to December 2000, at the Instituto de Cardiologia do Rio Grande do Sul/Fundação Universitária de Cardiologia, Porto Alegre, RS. Of 1149 patients treated with 1221 stents, 145 patients with coil stents were excluded. The other exclusion criteria were patients who had at least one of the following features: residual stenosis ≥ 30% (31), postprocedure vessel flow TIMI 0 or 1 (14), acute vessel occlusion immediately after the procedure or within the first 24 hours (33), procedure failure due to stent loss (1), procedure failure due to stent positioning outside the lesion (2), impossibility to cross the lesion with the stent (4), acute myocardial infarction related to the procedure (9), emergency surgery (4), and death within the first 24 hours of the procedure (12), amounting to 87 of the 998 patients experiencing angiographic failure, clinical failure, or acute ischemic complications within the first 24 hours of the procedure.

Patients included in the dissection group had clinically successful stent implantation without greater cardiovascular compli-

cations, and nonocclusive dissections (types A, B, or C of ACC) [8] not treated with a second stent. Patients included in the control group had clinical success, without major cardiovascular complications and residual dissections. All patients were prospectively included in an Access database, and their clinical and angiographic characteristics were assessed.

Stent implantation was performed according to standard techniques [18,19], and in most cases predilation with balloon angioplasty was performed. High-pressure use, type and number of stents used, coronary angioplasty in another lesion or another vessel, other devices used, glycoprotein IIb/IIIa inhibitors, and the other technical criteria were decided by the operators. All patients were treated during platelet inhibition using acetylsalicylic acid and thienopyridine; these drugs were administered during or soon after the procedure, in emergency cases. Stents used were the Multilink (Guidant/Advanced Cardiovascular Systems, Santa Clara, California) = 310 implants; Tenax (Biotronik, Berlin, Germany) = 266 implants; BX Velocity (Cordis/Johnson & Johnson Interventional, Warren, New Jersey) = 97 implants; NIR (Medinol Ltd., Tel Aviv, Israel) = 75 implants; Vflex (Cook Group Inc, Broomfield, CO, USA) = 68 implants; AVE GFX (Arterial Vascular Engineering, Inc., Santa Rosa, California) = 67 implants; Iris (Uni-Cath Inc, Saddle Brook, NJ, USA) = 35 implants; Jostent (JOMED AB, Helsinborg, Sweden) = 9 implants; Palmaz Schatz (Cordis/Johnson & Johnson Interventional, Warren, New Jersey) = 7 implants.

Angiographic evaluations were performed through measurements with a manual pachymeter by experienced operators; the reference diameter was the average of the proximal and distal diameters of the lesion. The severity of the stenosis was assessed immediately after the procedure in at least 2 orthogonal projections, considering the lesion with the most severe stenosis. The length of the lesion was measured along its entire extension (shoulder to shoulder), and long lesions were considered as single when there was less than 10mm of normal segment between them. The flow before and after the procedure was classified according to the TIMI [20] classification and the stenosis type according to criteria of the American College of Cardiology [21]. Thrombus was defined as a intraluminal defect; the lesion was considered eccentric when the stenosis was observed in the middle of a supposed normal lumen in at least 1 projection. The balloon/artery ratio was the ratio between the nominal diameter of the balloon used to expand the stent according to the manufacturer and the reference diameter of the vessel, as specified above. The aggressiveness score was the product of the balloon/artery ratio and the maximum pressure to implant the stent [22]. Regarding the type of stent, the sample was divided into the following 3 groups: first-generation stents (Palmaz Schatz, Vflex, Iris, Jostent, Wallstent, NIR, GFX), second-generation stents (Multilink, BX Velocity), and silicon carbide coated stents (Tenax).

Concerning the patient's clinical presentation before the procedure, stable angina was defined as stability in the pattern of triggering of the pain in the last 2 months. Unstable angina was considered as the worse intensity and/or frequency of the pattern of angina in the last 2 months before the procedure with or without chest pain at rest. Acute myocardial infarction was considered when the patient was sent for percutaneous revascularization due to chest pain and ST segment evolution. Regarding the indication for stent implantation, it was considered an elective procedure when the stent placement was indicated before the procedure. Suboptimal indication occurred when it was recommended after coronary angioplasty because of important residual lesions or elastic recoil, or as bailout when the procedure was performed with acute occlusion or a threat of coronary angioplasty occlusion.

Regarding the procedure results, angiographic success was defined as effective stent implantation in the most severe stenosis with residual stenosis < 30% and normal flow at the end of the procedure, and clinical success was defined as angiographic success without acute myocardial infarction, or the need for emergency revascularization, or death.

Regarding the results of the study, the occurrence of the following events was assessed at 1-year follow-up: major cardiovascular events, target vessel revascularization (coronary angioplasty or myocardial revascularization surgery), acute myocardial infarction and death. Major cardiovascular events were defined as the need for a new revascularization of the target vessel, acute myocardial infarction or death; target vessel revascularization as a new percutaneous intervention in the treated vessel or myocardial revascularization surgery; acute myocardial infarction as the appearance of new Q waves and chest pain lasting > 30 minutes or an episode of acute ischemic syndrome with ST segment depression and an indication of chemical or mechanical reperfusion, or an episode of acute ischemic syndrome without ST segment depression, but with electrocardiographic alterations and an enzyme increase with CK-MB 3 times greater than that of the control.

The patients were clinically followed-up in the outpatient ward, with personal assistance or by telephone with their attending physician, and the results were recorded in a dedicated database for later analysis. Control angiography was performed only when it was clinically indicated by each patient's attending physician.

The differences between the 2 groups were assessed by chi-square test or Fisher's exact test for categorical variables and the *t* test for continuous variables. The results were assessed through survival analysis by the Kaplan-Meier method, and the differences in the survival rates were assessed for statistical significance using the log-rank test. Logistic regression models were used to identify variables associated with major cardiovascular events at 1 year, with failures in the procedure and with dissections [23]. For all tests, $P \leq 0.05$ was considered statistically significant.

Results

We assessed 907 patients undergoing implantation of 960 stents (mean, 1.06 stent implantations per patient). The dissection group comprised 36 patients and the control group –comprised 871 patients.

There was no statistically significant difference regarding the mean age of both groups (dissection=57.83±9.76 vs. control=60.28±10.79; P=ns) or female frequency (dissection=39% vs. control=28%; P=ns). Regarding the presence of risk factors for ischemic heart disease, previous coronary intervention, and previous acute myocardial infarction, a statistically significant difference did not occur between the 2 groups, nor did it occur in the mean left ventricular ejection fraction before the procedure, the number of involved vessels, and clinical presentation (tab. I).

A statistically significant difference was not observed regarding the vessel treated or the site of stent implantation. The dissection

Table I - Clinical features of patients

	Dissection	Control	P
Number of patients	36	871	
Age, years	57.83 ± 9.76	60.28 ± 10.79	ns
Female	14 (39)	244 (28)	ns
Hypertension	14 (38)	315 (36)	ns
Smoking	15 (41)	368 (42)	ns
Familial history	14 (38)	304 (35)	ns
Dyslipidemia	21 (59)	395 (45.4)	ns
Diabetes mellitus	8 (21)	203 (23.3)	ns
Previous MRS	2 (6)	90 (10.4)	ns
Previous PCI	3 (8)	112 (12.9)	ns
Previous AMI	14 (36)	208 (23.9)	ns
Ejection fraction, %	69.36 ± 10.43	67.05 ± 13.16	ns
Involved vessels			ns
One	18 (50)	455 (52.2)	ns
Two	13 (35)	212 (24.4)	ns
Three	5 (15)	117 (13.5)	ns
Clinical presentation			ns
Stable angina	8 (22)	198 (22.8)	ns
Unstable angina	26 (72)	560 (64.4)	ns
AMI	2 (6)	110 (12.7)	ns
Cardiogenic shock	0	8 (0.9)	ns
IAB	0	4 (0.5)	ns
Glycoprotein inhibitor	0	29 (3.3)	ns

MRS - myocardial revascularization surgery; PCI - percutaneous coronary intervention; AMI - acute myocardial infarction; IAB - intra-aortic balloon; categorical variables: number of patients (Percentage); continuous variables: mean ± standard deviation

group had significantly smaller vessels than did the control group (dissection = 3.06±0.27 mm vs. control. = 3.32±0.42 mm; P<0.0001); however, there were no differences regarding the severity of the stenosis before the procedure, and minimal luminal diameter before the procedure or lesion length. Regarding the coronary flow before the procedure, the patients in the dissection group had significantly less TIMI flow grade 2 or 3 (dissection = 75.7% vs. control. = 87.2 %; P=0.04). As for the characteristics of the lesion to be treated, the dissection group had type C lesions more frequently than did the control group (dissection = 40.5% vs. control. = 21.5%; P=0.01). There were no statistically significant differences between the 2 groups regarding the other characteristics of the lesions, such as thrombus, presence of calcium, ulcerations, eccentricity, and excessive tortuosity of the vessel (tab. II).

The indications for stent implantation were similar in both groups; however, the dissection group was treated with longer stents (dissection = 17.3±4.72 mm vs. = 15.76±4.48 mm; P=0.05), and the control group with second-generation stents (dissection = 16.2% vs. control = 43.7%; P=0.04). There were no differences regarding the mean of the pressures used, the size of the balloon, or the aggressiveness score, but the balloon/artery ratio was significantly greater in the dissection group (dissection = 1.07±0.09 vs. control = 1.00±0.09; P<0.0001). Luminal diameter at the end of the procedure was significantly lower in the dissection group (dissection = 3.15±0.35 mm vs. control = 3.34±0.40 mm; P<0.003), but there was no difference regarding residual stenosis after the implant (tab. III).

During the study period, 87 patients were identified with clinical or angiographic failure, or with major ischemic complications within the first 24 hours of the procedure. They were not included in the groups assessed but were described only for comparison with the sample studied (tab. IV). Using multivariate analysis, only bailout stenting, cardiogenic shock, and angiographically visible calcium were independently associated with failure or major ischemic complications (tab. V).

No differences were found between the 2 groups regarding in-hospital outcomes, because we only selected patients with successful procedures and no complications. Regarding the incidence of major cardiovascular events at 1 year, there was no statistically significant difference between the 2 groups (dissection = 17.1% vs. control = 9.5%; P=0.14) (tab. VI). Survival analysis with Kaplan-Meier curves and comparisons with the log-rank test did not demonstrate statistically significant differences between the 2 groups (fig. 1). Regarding other 1-year outcomes, statistically significant differences were not observed between the 2 groups, although the dissection group tended to have adverse results more frequently (tab. VI).

The dissection group had a nonsignificant tendency towards worse outcomes, but it also more frequently had several clinical and angiographic characteristics associated with a worse prognosis. Multivariate analysis was performed with these unfavorable characteristics, analyzing their relationship with clinical outcomes. In this multiple logistic regression model, the incidence of major cardiovascular events at 1 year was the dependent variable; the dissection, reference diameter, postimplant residual stenosis, diabetes mellitus, type of stent implanted, type of treated lesion, and extension of the lesion were the independent variables. Reference diameter (odds ratio = 0.33, confidence interval 0.17-0.65; P=0.001), residual stenosis (odds ratio=1.04, confidence interval 1.01-1.07; P=0.01) and lesion extension (odds ratio = 1.09, confidence interval 1.03-1.15; P=0.002) were independently associated with major cardiovascular events at 1 year rather than the presence of postimplant dissection (tab. VII).

Multivariate analysis was performed to identify factors independently associated with dissections. Reference diameter, balloon/artery ratio, type of lesion, and stent length were the independent variables used; dissection was the dependent variable. In this analysis, only the reference diameter and the balloon/artery ratio were independently associated with dissection.

Discussion

Uncomplicated residual dissections were associated with smaller vessels and a greater balloon/artery ratio. One-year clinical follow-up of patients with residual dissections was not significantly different from the control group. The factors independently associated with major cardiovascular events in the multivaried analysis were reference diameter, residual stenosis, and lesion extension, rather than the presence of dissection.

Although atherosclerotic plaque rupture is a sine qua non condition for an effective coronary angioplasty, the incidence of angiographically visible dissections is 30% after balloon angioplasty and 5 to 10% after stent implantation [1-4,14]. The factors associated with coronary dissections after conventional angioplasty are angiographic calcification [2], lesion extension [2,14], balloon/artery ratio [1,2], complex lesions [7-15], presence of other lesions in the same vessel [2], female gender [13], low cholesterol [14], stable angina [14], right coronary artery intervetion [14], lesions in a curve [14], postprocedure thrombus [14], high pressures [14], and noncompliant balloon [14]. The predictive fac-

Table II - Angiographic characteristics of the procedures

	Dissection	Control	P
Number of procedures	37	923	
Treated vessel			
Left main	0	7 (0.8)	ns
Anterior descendent	22 (59.5)	477 (51.7)	ns
Circumflex	4 (10.8)	121 (13.1)	ns
Right	10 (27.0)	271 (29.4)	ns
Saphenous vein graft	1 (2.7)	46 (5.0)	ns
Lesion site			
Ostial	0	12 (1.3)	ns
Proximal	25 (67.6)	566 (61.3)	ns
Medial	12 (32.4)	302 (32.7)	ns
Distal	0	43 (4.7)	ns
Reference diameter, mm	3.06 ± 0.27	3.32 ± 0.42	<0.0001
Stenosis severity, %	82.49 ±11.99	84.21 ±10.62	ns
Minimum luminal diameter, mm	0.54 ± 0.36	0.53 ± 0.36	ns
Length of the lesion, mm	11.59 ± 5.94	10.15 ± 4.60	ns
Lesions greater than 10 mm	18 (48.6)	396 (42.9)	ns
Vessel flow before the stent (TIMI)			
0/1	9 (24.3)	118 (12.8)	0.07
2/3	28 (75.7)	805 (87.2)	0.04
Type of lesion (ACC classification)			
A	1 (2.7)	28 (5.3)	ns
B1	67 (13.5)	171 (18.5)	ns
B2	16 (43.2)	500 (54.2)	ns
C	15 (40.5)	198 (21.5)	0.01
Thrombus	30 (81.1)	723 (78.3)	ns
Calcium	8 (21.6)	141 (15.3)	ns
Ulceration	13 (35.1)	230 (24.9)	ns
Branch involvement	13 (35.1)	375 (40.6)	ns
Eccentricity	31 (83.8)	816 (88.5)	ns
Excessive tortuosity	2 (5.4)	30 (3.3)	ns

mm - millimeters; TIMI - thrombolysis in myocardial infarction; ACC - American College of Cardiology; categorical variables: number of procedures (percentages); continuous variables: mean ± standard-deviation

tors for severe ischemic complications secondary to dissections were balloon/artery ratio [1], dissection extension [5,7,8], presence of a significant residual stenosis [6,7], and the type of dissection according to the ACC [8] classification. Despite the importance of these angiographic data, most studies demonstrate that the clinical status of the patient at the time of angioplasty, that is, the presence of angina, electrocardiogram alterations, and/or hemodynamic involvement, is the greatest predictor of acute ischemic complications.

In our study, we have demonstrated that the reference diameter of the treated vessel and the balloon/artery ratio rather than the lesion type, were independently associated with dissections. These results emphasize the importance of a proper balloon/artery ratio in the prevention of dissections, especially in narrower vessels. Also, the type of lesion is not associated with the dissections after stent implantation, unlike what is seen after conventional angioplasty.

Some studies demonstrate that no association exists between residual dissections and worse late clinical outcomes in patients undergoing coronary angioplasty. Leimgruber et al [13] reported similar rates of angiographic restenosis in 986 patients with or without dissection, with the exception of those with final transstenotic gradients < 15 mmHg, who experienced better evolvement. Hermans et al [14] studied a prospective series of 693 patients with angiographic follow-up in 94% of cases, demonstrating that a successful angioplasty with residual dissection does not increase restenosis. Cappelletti et al [15] demonstrated that most dissections disappear during angiographic follow-up and that patients with uncomplicated dissections have lower restenosis rates than do those without dissections. They have also reported that patients with uncomplicated dissections treated with a stent have higher restenosis rates than do those without stent implantation to treat the dissection [15]. However, these results are only applicable when angioplasty is successful, without significant residual stenosis, or significant contrast retention or flow compromise.

On the other hand, a few studies have assessed long-term clinical follow-up of patients treated with coronary stents. Even uncomplicated residual dissections are associated with subacute thrombosis after stent implantation, or implant of multiple stents [9]. Cutlip et al [24] assessed the clinical follow-up of patients with suboptimal implants, either by the presence of residual dissections, multiple stents, flow involvement during the procedure, or residual thrombus. Through multivariate analysis, lower final luminal diameter, a higher number of stents, and the absence of treatment with ticlopidine were related to cardiovascular events in 30 days. Final luminal diameter, a higher number of stents, and diabetes mellitus were related to revascularization rates of the target vessel at 9 months. Dissections were not independently associated with adverse clinical outcomes in 30 days or 9 months. Alfonso et al [17] reported the clinical follow-up of 17 patients with residual dissections after stent implantation and without coronary flow compromise. In the control angiography, all dissections had disappeared, and even the patients with more extensive dissections did not have restenosis, concluding, therefore, that patients with residual dissections may have a good clinical follow-up, as long as no coronary flow involvement or significant residual stenosis are present.

Table III - Aspects related to the procedure

	Dissection	Control	P
Number of procedures	37	923	
Indication			
Elective	17 (47.2)	534 (57.9)	ns
Suboptimal result	15 (41.7)	332 (36.0)	ns
Bailout	4 (11.1)	56 (6.1)	ns
Type of stent			
First generation	15 (40.5)	262 (28.4)	ns
Second generation	6 (16.2)	403 (43.7)	0.04
Silicon carbide	16 (43.2)	258 (28.0)	ns
Stent length, mm	17.3 ± 4.72	15.76 ± 4.48	0.05
Pressure implantation, ATM	12.97 ± 3.01	13.21 ± 2.57	ns
Balloon diameter, mm	3.26 ± 2.50	3.30 ± 0.38	ns
Residual stenosis, %	- 0.92 ± 8.94	- 0.33 ± 8.73	ns Fi-
nal luminal diameter, mm	3.15 ± 0.35	3.34 ± 0.40	0.003
Balloon/artery ratio, mm	1.07 ± 0.09	1.00 ± 0.09	<0.0001
Aggressiveness score, U	13.89 ± 3.42	13.19 ± 2.75	ns
Another PTCA			
None	31 (83.8)	811 (87.9)	ns
1	6 (16.2)	99 (10.7)	ns
2	0	13 (1.4)	ns
Stents/patient number			
1	32 (86.5)	824 (89.3)	ns
2	5 (13.5)	87 (9.4)	ns
3	0	12 (1.3)	ns

mm - millimeters; ATM - atmosphere; another PTCA (percutaneous transluminal coronary angioplasty) performed in lesion not treated with stent; U - units; categorical variables: number of procedures (percentages); continuous variables: mean ± standard-deviation

Table IV - Characteristics associated with procedure failure: unvariate analysis

	Failure	Success	P
Number of patients	87	907	
Age, years	61.67±10.66	60.14±10.75	Ns
Female	31 (35.6)	261 (28.8)	Ns
Developing AMI	31 (35.6)	112 (12.4)	0.0001
Bailout starting	23 (26.7)	54 (6.0)	0.0001
Cardiogenic shock	12 (13.8)	7 (0.8)	0.0001
Left main lesion	4 (4.7)	6 (0.7)	0.01
Type C lesions (ACC)	39 (45.3)	197 (21.7)	0.0001
Calcified lesions	23 (26.4)	135 (14.9)	0.006
Diabetes mellitus	28 (32.4)	204 (22.5)	0.05
Severity of the lesion, %	87.22±11.22	84.25±10.65	0.01
Stent length, mm	17.21±4.71	15.84±4.46	0.01

mm: millimeters; categorical variables: number of patients (percentages); continuous variables: mean ± standard-deviation

Table V - Characteristics associated with procedure failure: multivariate analysis

	Odds ratio	Confidence interval	P
Bailout starting	5.32	2.34 - 12.13	0.0001
Cardiogenic shock	10.23	3.10 - 33.80	0.0001
Calcium	2.10	1.13 - 3.89	0.02

Table VI - One-year follow-up

	Dissection	Control	p
Number of patients	35	836	
Coronary angioplasty	3 (8.6)	39 (4.6)	0.23
Revascularization surgery	2 (5.7)	26 (3.1)	0.307
Acute myocardium infarction	2 (5.8)	27 (3.2)	0.32
Death	1 (2.9)	25 (3.0)	1.0
Target vessel revascularization	5 (14.3)	63 (7.5)	0.182
Major cardiovascular events	6 (17.1)	79 (9.5)	0.14

Number of patients (percentages), cumulative

In our study, we have also demonstrated that there was no association between the presence of uncomplicated residual dissections after coronary stent implantation and adverse clinical events at 1-year follow-up. Although the dissection group has a tendency toward poorer outcomes, the presence of dissections was not independently associated with major cardiovascular events in the multivariate analysis. As the dissections were associated with smaller vessels, longer stents, and more complex lesions, and these factors are associated with greater restenosis rates, the differences in outcomes between the 2 groups may be explained by these differences rather than by the occurrence of dissections. Studies with angiographic follow-up have demonstrated that most nonocclusive dissections "seal" in some days or weeks, which explains the absence of a correlation between dissection and restenosis.

This study demonstrates that the presence of uncomplicated residual dissections after stent implantation is not independently associated with worse late clinical outcomes, therefore, suggesting

Table VII - Multiple logistic regression of variables associated with major cardiovascular events at 1-year follow-up

	Odds ratio	Confidence interval	Wald	B	P
Reference diameter	0.33	0.17-0.65	10.36	-1.11	0.001
Residual stenosis	1.04	1.01-1.07	6.16	0.036	0.01
Lesion length	1.09	1.03-1.15	9.97	0.08	0.002
Type of lesion	1.65	0.34-8.09	0.39	0.50	0.53
Type of stent	1.09	0.57-2.11	0.07	0.08	0.79
Diabetes melittus	1.67	1.00-2.78	3.84	0.51	0.05
Dissection	1.20	0.43-3.39	0.12	0.19	0.72
Constant			0.0492	-0.2945	0.8244

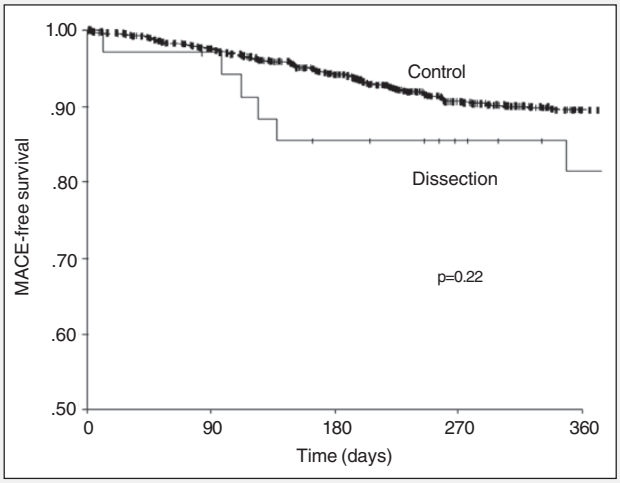

Fig. 1 - Major cardiovascular events (MACE) at 1 year.

that these patients probably do not need a more strict angiographic or clinical follow-up after the first days of the procedure. The factors independently associated with restenosis in our study are similar to those already described, such as reference diameter, residual stenosis after the procedure, and lesion extension [10-12,25-28]. We have also demonstrated that higher balloon/artery ratios and narrower vessels are associated with dissections; this finding should direct technicians to optimize the stent size, especially in patients with smaller vessels. These recommendations are also corroborated by previous studies, demonstrating that oversized balloons are more frequently used in patients with smaller vessels. Finally, another important observation to be considered is that morphologic characteristics of the treated lesion do not influence the occurrence of dissections after stent implantation, in contrast with that observed after conventional angioplasty.

Although the data assessed in this study have been prospectively collected, the classification of the patients into groups (with or without dissection) was retrospectively performed, with the biases resulting from this kind of division. The findings reported do not help to predict acute ischemic events after dissections, because studies with a larger number of patients have already demonstrated that the presence of dissections, significant residual stenosis, total length of the implanted stent, and the luminal diameter are important predictors of subacute thrombosis. Intracoronary ultrasound has proven to be a sensitive technique for detecting dissections, and its use could add additional information that was not taken into account in this analysis.

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