Impact of Bifurcation Technique on 2-Year Clinical Outcomes in 773 Patients With Distal Unprotected Left Main Coronary Artery Stenosis Treated With Drug-Eluting Stents

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Background—Distal unprotected left main coronary artery (ULMCA) stenosis represents a technical challenge for interventional cardiologists. In this study, we compared 2-year clinical outcomes of different stenting strategies in patients with distal ULMCA stenosis treated with drug-eluting stents.

Methods and Results—The survey promoted by the Italian Society of Invasive Cardiology on ULMCA stenosis was an observational study on patients with ULMCA stenosis treated with percutaneous coronary intervention. In this study, we selected patients with distal ULMCA stenosis treated with drug-eluting stents. Seven hundred seventy-three patients were eligible for this study: 456 were treated with 1 stent (group 1) and 317 with 2 stents (group 2). The primary end point of the study was the incidence of major adverse cardiac events (MACEs), defined as the occurrence of mortality, myocardial infarction, and target lesion revascularization. During a 2-year follow-up, risk-adjusted survival free from MACE was significantly higher in patients in group 1 than in patients in group 2. The propensity-adjusted hazard ratio for the risk of 2-year MACE in patients in group 1 versus group 2 was 0.53 (95% CI, 0.37 to 0.76). The propensity-adjusted hazard ratio for the risk of 2-year cardiac mortality and myocardial infarction in patients in group 1 versus group 2 was 0.38 (95% CI, 0.17 to 0.85).

Conclusions—Compared with the 2-stent technique, the 1-stent technique is associated with a better 2-year MACE-free survival. The stenting strategy is a prognostic factor that should be taken into account when deciding the optimal revascularization treatment. (Circ Cardiovasc Intervent. 2008;1:185-192.)

Key Words: mortality ■ restenosis ■ stents

The introduction of drug-eluting stents (DESs) has renewed the interest for the percutaneous treatment of the unprotected left main coronary artery (ULMCA) stenosis. Several studies have shown that DESs significantly reduce the incidence of major adverse cardiac events (MACEs) when compared with bare metal stents.1—4 Moreover, some observational registries have indicated similar rates of mortality and myocardial infarction (MI) between DES-treated patients and those treated with surgery.5—9 However, bifurcation lesions still remain a challenge also for DES.10 One recent study has shown that patients with distal ULMCA stenosis have an increased risk of MACE compared with patients with ostial and midshaft lesion even if treated with DES and that bifurcation is an independent predictor of adverse events at follow-up.11

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A major issue connected with the treatment of bifurcation lesions concerns the optimal strategy of stenting. Few studies have tried to address this issue, and they enrolled a limited number of patients who were followed up for ≤1 year. In particular, there is uncertainty whether the strategy of stenting both vessels provides better outcomes than that of stenting only 1 vessel. Moreover, several 2-stent techniques are currently available (T-stenting, V-stenting, culotte, crush stenting), and how these techniques compare with one another is not known. In this study, we report the 2-year clinical outcomes of 773 patients with distal ULMCA stenosis treated with DES enrolled in the survey sponsored by the Italian Society of Invasive Cardiology (GISE-SICI).

Methods

Patients

The GISE-SICI survey on ULMCA stenosis is a multicenter, retrospective, observational study performed in patients with ULMCA stenosis treated with percutaneous coronary intervention (PCI). All interventional high-volume centers, performing >800 PCIs per year in Italy and affiliated with GISE-SICI were asked to participate in the survey by providing demographic, clinical, procedural, and follow-up data on consecutive patients with ULMCA stenosis treated with PCI between January 2002 and December 2006. A list of the most important variables was compiled in accordance with international recommendations and each center was asked to provide the requested information. All data provided by each interventional center were centrally collected and analyzed. The inclusion criterion for the survey was the presence of a >50% stenosis of the left main that was not protected by a patent coronary bypass graft to either the left anterior descending artery or circumflex artery. We excluded patients with ST-segment elevation acute MI necessitating primary PCI or patients who presented with cardiogenic shock.

In this article, we report the 2-year clinical outcome of those patients with distal lesions treated with DES. Distal ULMCA stenosis was defined as a >50% lesion involving both distal left main and the origin of at least 1 of the arteries stemming from the left main. The decision to perform PCI instead of coronary artery bypass graft reflected the current practice and strategy of each center according to its indications and protocols to treat ULMCA stenosis. The use of the various devices as well as the administration of therapies during the procedure was left to the operator’s discretion. Total creatinphosphokinase and the isoenzyme muscle-brain were collected in all patients after 6 hours and again the morning after the intervention. We excluded patients with ST-segment elevation acute MI necessitating primary PCI or patients who presented with cardiogenic shock.

Statistical Analysis

The primary end point of the study was the incidence of MACE at 2-year follow-up. In the computation of the primary end point, events were counted only once, whichever occurred first. All other comparisons were considered secondary objectives of the study. Data are presented as mean±SD or median and range, as appropriate. Continuous data between groups were compared using unpaired t test or Mann–Whitney rank sum test. Categorical variables were compared by χ² or Fisher exact test as appropriate. Survival, survival free from cardiac death, MI-free survival, TLR-free survival, and MACE-free survival were analyzed by the Kaplan–Meier method, and differences between groups were analyzed with the log-rank test. In the analysis of MI-free and TLR-free survival, death was regarded as a censoring event.

Independent predictors of 2-year MACE were analyzed using Cox proportional hazards regression model. Two criteria were considered necessary for a variable to be entered in the model: a plausible association with the risk of MACE and an availability in the database ≥85%. Therefore, the following variables were included in the model: the bifurcation technique (1 stent versus 2 stents), age, gender, diabetes, acute coronary syndrome, renal dysfunction, kissing balloon, multivessel disease, and left ventricular ejection fraction (LVEF). The proportional hazard assumptions of the model were assessed by plotting the scaled Schoenfeld residuals against time and the linearity assumption was assessed by plotting the Martingale residuals against continuous covariates. All patients were censored at 2 years. Patients lost to follow-up were considered at risk until the date of last contact, at which point they were censored.

Given the nonrandomized nature of the study, to minimize any selection bias a second multivariable analysis was performed using the propensity score as a covariate. The propensity score was determined by use of a logistic regression model from which the probability of receiving 1 stent rather than 2 stents was calculated for each patient. The following variables were included in the model: age, gender, hypertension, diabetes, hypercholesterolemia, smoking, acute coronary syndrome, renal dysfunction, Euroscore, LVEF, kissing balloon, multivessel disease, and the use of glycoprotein IIb–IIIa inhibitors. Model discrimination was assessed with the c statistic and model calibration with the Hosmer-Lemeshow statistic. Each patient’s propensity score was calculated from the sum of the values for all variables in the model multiplied by their respective logistic coefficient. A Cox regression analysis was then performed on 2-year MACE using as covariates the technique used (1 stent versus 2 stents) and the propensity score as a simple linear term. Then, to analyze the impact of the stenting strategy on hard end point, we performed a propensity-adjusted Cox regression analysis on the risk of 2-year cardiac mortality and MI. To assess the relative efficacy of the various 2-stent techniques used in this study, Kaplan–Meier analyses of survival and event-free survival were generated by evaluating patients treated with T-stenting, V-stenting, and crush stenting. To adjust for possible confounding factors, a multivariable Cox regression analysis was performed using as covariates all variables previously specified. Statistical analyses were performed using SPSS 12.0 for Windows (SPSS Inc, Chicago, Ill) and STATA/SE 9.2 for Windows (StataCorp, College Station, Tex). P values <0.05 were considered statistically significant.

Definitions

MACEs were defined as the occurrence of death, MI, or target lesion revascularizations (TLRs). Acute coronary syndrome was defined as either unstable angina or non-ST segment elevation MI. The diagnosis of non-ST-segment elevation MI was based on the presence of typical symptoms and an increase in troponin levels. The diagnosis of periprocedural MI was made if after PCI there was an increase in creatinphosphokinase levels that was 3 times the upper normal level, with the isoenzyme muscle-brain >10%. Peripheral vascular disease was defined as the presence of at least 1 of the following: symptomatic or >50% asymptomatic carotid stenosis, abdominal aortic aneurysm, claudication, or previous or planned intervention on the abdominal aorta, limb arteries, or carotids. Renal dysfunction was defined as serum creatinine levels >2 mg/dl.

TLR was defined as repeated PCI or coronary artery bypass grafting surgery for restenosis of the entire segment involving the implanted stent and the 5-mm distal and proximal borders adjacent to the stent. Deaths were classified as either cardiac or noncardiac. Deaths that could not be classified were considered cardiac.
groups. Unadjusted rates of mortality, cardiac mortality, and MI were similar between the 2 groups. Survival, survival free from cardiac death, MI-free survival and TLR-free survival were 90.4%, 92.3%, 96.5%, and 87.0% in group 1 and 92.2%, 95.7%, 96.4%, and 73.1% in group 2, respectively (Figure 2).

The multivariable Cox regression analyses adjusted for covariates showed a significantly lower risk of 2-year MACE in patients in group 1 than in patients in group 2. The adjusted hazard ratio for the risk of 2-year MACE in patients in group 1 relative to patients in group 2 was 0.48 (95% CI, 0.33 to 0.69). Other variables significantly associated with the risk of 2-year MACE were age, diabetes, acute coronary syndrome, renal dysfunction, LVEF, and kissing balloon postdilatation (Table 2). Similarly, the propensity-adjusted Cox regression analysis showed a significant lower hazard of 2-year MACE in patients in group 1 than in patients in group 2. The hazard ratio for the risk of 2-year MACE in patients in group 1 relative to patients in group 2 was 0.53 (95% CI, 0.37 to 0.76; P=0.001). Because the patients in group 1 were at higher risk than the patients in group 2, we then analyzed the impact of the stenting strategy on the risk of 2-year cardiac mortality and MI adjusting for the propensity score (Figure 3). The propensity-adjusted Cox regression analysis showed a significantly lower risk of 2-year cardiac mortality and MI in patients in group 1 than in patients in group 2 (hazard ratio, 0.38; 95% CI, 0.17 to 0.85; P=0.02).

Two-Year Clinical Outcomes With the 2-Stent Technique
Clinical characteristics of patients of group 2 in relation to the treatment approach (T-stenting, V-stenting, and crush stenting) are shown in Table 3. We excluded the patients treated with the culotte technique from the analysis because of the limited number of cases (5 patients). MACE-free survival was similar among the 3 groups: it was 66.5% in patients treated with T-stenting, 69.3% in those treated with V-stenting, and 66.9% in those treated with crush stenting. In particular, the incidence of mortality, cardiac mortality, MI, and TLR were the same, irrespective of the technique used (Figure 4). In the multivariable Cox regression analysis, no significant

### Table 1. Clinical, Anatomic, and Procedural Characteristics

<table>
<thead>
<tr>
<th></th>
<th>1 Stent (n=456)</th>
<th>2 Stents (n=317)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, median (range)</td>
<td>72 (29–97)</td>
<td>70 (37–90)</td>
<td>0.026</td>
</tr>
<tr>
<td>Male, n (%)</td>
<td>331 (73.6)</td>
<td>244 (77.2)</td>
<td>0.17</td>
</tr>
<tr>
<td>Systemic hypertension, n (%)</td>
<td>317 (72.2)</td>
<td>208 (67.9)</td>
<td>0.24</td>
</tr>
<tr>
<td>Diabetes mellitus, n (%)</td>
<td>146 (33.0)</td>
<td>75 (24.3)</td>
<td>0.01</td>
</tr>
<tr>
<td>Hypercholesterolemia, n (%)</td>
<td>277 (63.4)</td>
<td>209 (68.3)</td>
<td>0.19</td>
</tr>
<tr>
<td>Present or previous smoking habits, n (%)</td>
<td>167 (38.5)</td>
<td>105 (34.7)</td>
<td>0.32</td>
</tr>
<tr>
<td>Acute coronary syndrome, n (%)</td>
<td>262 (57.9)</td>
<td>149 (47.5)</td>
<td>0.005</td>
</tr>
<tr>
<td>Unstable angina, n (%)</td>
<td>137 (29.3)</td>
<td>91 (27.9)</td>
<td>0.09</td>
</tr>
<tr>
<td>NSTEMI, n (%)</td>
<td>96 (21.7)</td>
<td>43 (13.6)</td>
<td></td>
</tr>
<tr>
<td>Chronic pulmonary disease, n (%)</td>
<td>34 (10.4)</td>
<td>25 (10.5)</td>
<td>0.91</td>
</tr>
<tr>
<td>Renal dysfunction, n (%)</td>
<td>48 (11.4)</td>
<td>33 (10.8)</td>
<td>0.90</td>
</tr>
<tr>
<td>Peripheral vascular disease, n (%)</td>
<td>80 (25.6)</td>
<td>45 (18.9)</td>
<td>0.08</td>
</tr>
<tr>
<td>Euroscore, median (range)</td>
<td>5 (0–18)</td>
<td>4 (0–14)</td>
<td>0.007</td>
</tr>
<tr>
<td>LVEF, median (range)</td>
<td>55 (20–80)</td>
<td>55 (20–80)</td>
<td>0.75</td>
</tr>
<tr>
<td>Multivessel disease, n (%)</td>
<td>256 (59.7)</td>
<td>166 (51.5)</td>
<td>0.25</td>
</tr>
<tr>
<td>Multivessel treatment, n (%)</td>
<td>121 (32.0)</td>
<td>90 (28.8)</td>
<td>0.69</td>
</tr>
<tr>
<td>Glycoprotein IIb–IIIa inhibitors, n (%)</td>
<td>125 (27.5)</td>
<td>110 (32.8)</td>
<td>0.47</td>
</tr>
<tr>
<td>Kissing balloon postdilatation, n (%)</td>
<td>196 (48.6)</td>
<td>255 (81.2)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

NSTEMI indicates non-ST segment elevation acute myocardial infarction.

### Results

#### Patients
From January 2002 to December 2006, 777 patients with distal ULMCA stenosis were treated with DES in 19 high-volume interventional centers belonging to GISE-SICI. Four patients were excluded because data on the technique used were not available, and therefore, the final cohort of patients consisted of 773 patients. Clinical characteristics of patients enrolled according to the technique used are shown in Table 1. Patients treated with the 1-stent technique (group 1) presented a higher clinical risk profile than patients treated with the 2-stent technique (group 2): they were older, had higher Euroscores, and had more frequent diabetes and acute coronary syndromes. Among patients in group 2, 128 were treated with T-stenting, 60 with V-stenting, 5 with culotte, and 121 with crush stenting.

#### Two-Year Clinical Outcomes: 1-Stent Technique Versus 2-Stent Technique
The incidence of 2-year MACE, the primary end point of the study, was significantly lower in patients in group 1 compared with that in patients in group 2 (Figure 1). MACE-free survival at 2-year follow-up was 75.3% in patients in group 1 and 67.6% in patients in group 2 (P=0.02). The difference in the incidence of MACE unadjusted for confounders was driven entirely by the different incidence of TLR in the 2

#### Figure 1. Kaplan–Meier analysis of survival free from MACE in patients treated with 1 stent compared with patients treated with 2 stents.
advantage of 1 technique over the other could be observed. LVEF and kissing balloon postdilatation were the only covariates associated with the risk of 2-year MACE (Table 2).

Discussion
The treatment of distal ULMCA stenosis is associated with an increased risk of MACE compared with ostial or midshaft lesions, and it still represents a technical challenge to interventional cardiologists. A major issue connected with the treatment of distal ULMCA stenosis concerns the optimal strategy of stenting. Few studies have addressed this issue comparing different treatment approaches, and the results are controversial. In 1 study, single vessel stenting performed equally to bifurcation stenting with respect to clinical outcomes in 94 patients with distal ULMCA stenosis. Instead, in the study by Kim et al., patients treated with 1 stent (67 patients) had a significantly lower incidence of TLR than patients treated with a more complex technique (49 patients). Those studies enrolled a limited number of patients, and therefore, no definitive conclusion can be drawn. Theoretically, the availability of DES and the possibility of fully covering the carina of the left main using 2 stents, thereby facilitating drug delivery, make the double stenting technique particularly appealing in this setting. On the other hand, the higher amount of metal with overlapping strata used with the 2-stent technique could be associated with an increased hazard of stent thrombosis. These issues and the lack of studies with adequate sample sizes warrant additional clinical data to establish how these techniques compare with one another with respect to clinical outcomes.

To the best of our knowledge, our study is the first to report on the 2-year clinical outcome in a large series of patients with distal ULMCA stenosis treated with DES. Main findings of this study are as follows: (1) single vessel stenting was performed in the majority of patients, suggesting that this technique may be applied to a large proportion of patients with distal ULMCA stenosis; (2) compared with the 2-stent technique, the 1-stent technique was associated with a significant reduction in the incidence of 2-year MACE, driven not only by a significant reduction of TLR but also by a significant reduction of cardiac mortality and MI; and (3) among patients treated with the 2-stent technique, the different treatment approaches (T-stenting, V-stenting, and crush stenting) provided similar clinical outcomes.

These findings are in line with the recent studies that have compared different strategies of revascularization for non-

Figure 2. Kaplan–Meyer analysis of survival (A), survival free from cardiac mortality (B), survival free from MI (C), and survival free from TLR (D) in patients treated with 1 stent compared with patients treated with 2 stents.
toward better clinical outcomes. Considering the results of the upcoming randomized trials comparing PCI with surgery.

Several 2-stent techniques are currently available to treat bifurcation lesions, but how these techniques compare with one another is still a matter of debate. Whenever using one technique rather than another when treating distal ULMCA stenosis, the angle of the bifurcation, the burden of atherosclerotic lesions, the extension of disease in the left main carina, the involvement, and the diameter of the circumflex artery and the relation between the diameter of the left main and the diameter of the stemming arteries are all factors that should be also taken into account when treating distal ULMCA stenosis. Although we acknowledge that specific combinations of these factors make sometimes one technique preferable over another or make unsuitable the use of a particular technique, the main message of our study is that, whenever possible, 1-stent technique should be the preferred strategy when treating distal ULMCA stenosis. This strategy may be undertaken in the majority of patients, and it is associated with good midterm outcomes. In our study, 60% of patients were treated with single stenting, and the incidence of MACE at 2 years was around 25%. The advantage of using the 1-stent technique consisted not only in a significant reduction of TLR but also in a significant reduction of cardiac mortality and MI. Therefore, although our study is not randomized, the higher risk of cardiac mortality and MI observed in patients treated with the 2-stent technique compared with patients treated with the 1-stent technique raises some concerns and it is tempting to speculate that the 1-stent strategy followed by final kissing balloon postdilation is superior to the 2-stent strategy in treating bifurcation lesions and in particular distal ULMCA stenosis. However, this interpretation invites caution because our study was not randomized and it is not possible to rule out that patients who received 2 stents had a more complex anatomy and more plaque burden, placing these patients at a higher risk of both restenosis and harder clinical events. In fact, although we adjusted for several clinical variables, the decision to implant 2 stents rather than 1 stent is virtually never taken according to clinical factors, but it is mainly based on anatomic factors. Conversely, in the only 2 randomized trials currently available for non–left main bifurcated lesions, not only restenosis at the side branch was found to occur 2 to 3 times higher in the 2-stent strategy, but also the rate of thrombotic events was higher in this subgroup of patients.

Several factors may influence the decision to use one technique rather than another when treating distal ULMCA stenosis. The angle of the bifurcation, the burden of atherosclerotic lesions, the extension of disease in the left main carina, the involvement, and the diameter of the circumflex artery and the relation between the diameter of the left main and the diameter of the stemming arteries are all factors that are to be taken into account when treating distal ULMCA stenosis. Although we acknowledge that specific combinations of these factors make sometimes one technique preferable over another or make unsuitable the use of a particular technique, the main message of our study is that, whenever possible, 1-stent technique should be the preferred strategy when treating distal ULMCA stenosis. This strategy may be undertaken in the majority of patients, and it is associated with good midterm outcomes. In our study, 60% of patients were treated with single stenting, and the incidence of MACE at 2 years was around 25%. The advantage of using the 1-stent technique consisted not only in a significant reduction of TLR but also in a significant reduction of cardiac mortality and MI. Therefore, although our study is not randomized, the higher risk of cardiac mortality and MI observed in patients treated with the 2-stent technique compared with patients treated with the 1-stent technique raises some concerns and it strongly warns against a too liberal use of the double stenting technique. Moreover, the results of our study pose the question on whether the stenting strategy should be considered as a novel stratification factor when deciding the optimal strategy of revascularization between PCI and surgery for left main disease. Considering the very favorable outcome of patients treated with 1 stent followed by final kissing balloon postdilation, it is possible that PCI represents a reasonable alternative to surgery when the procedure can be accomplished using 1 stent only, whereas in more complex anatomies or other conditions requiring double stenting, it is likely that surgery is the preferred treatment. These considerations should be also taken into account when interpreting the results of the upcoming randomized trials comparing PCI with surgery.

Several 2-stent techniques are currently available to treat bifurcation lesions, but how these techniques compare with one another is still a matter of debate. Whenever using a 2-stent technique, it is generally believed that a technique
Table 3. Clinical, Anatomic, and Procedural Characteristics in Patients Treated With the 2-Stent Technique

<table>
<thead>
<tr>
<th></th>
<th>T-Stenting (n=128)</th>
<th>V-Stenting (n=60)</th>
<th>Crush (n=121)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, median (range)</td>
<td>69 (43–89)</td>
<td>69 (37–85)</td>
<td>71 (40–90)</td>
<td>0.37</td>
</tr>
<tr>
<td>Male, n (%)</td>
<td>94 (74.0)</td>
<td>51 (85.0)</td>
<td>94 (77.7)</td>
<td>0.24</td>
</tr>
<tr>
<td>Systemic hypertension, n (%)</td>
<td>88 (69.3)</td>
<td>31 (71.7)</td>
<td>75 (63.6)</td>
<td>0.65</td>
</tr>
<tr>
<td>Diabetes mellitus, n (%)</td>
<td>27 (21.3)</td>
<td>16 (28.6)</td>
<td>31 (26.3)</td>
<td>0.49</td>
</tr>
<tr>
<td>Hypercholesterolemia, n (%)</td>
<td>97 (76.4)</td>
<td>31 (58.5)</td>
<td>73 (61.9)</td>
<td>0.02</td>
</tr>
<tr>
<td>Present or previous smoking habits, n (%)</td>
<td>41 (32.8)</td>
<td>15 (28.8)</td>
<td>47 (39.8)</td>
<td>0.31</td>
</tr>
<tr>
<td>Acute coronary syndrome, n (%)</td>
<td>73 (57.9)</td>
<td>19 (32.2)</td>
<td>54 (44.6)</td>
<td>0.003</td>
</tr>
<tr>
<td>Unstable angina, n (%)</td>
<td>52 (71.2)</td>
<td>9 (60)</td>
<td>28 (65.1)</td>
<td></td>
</tr>
<tr>
<td>NSTEMI, n (%)</td>
<td>21 (28.8)</td>
<td>6 (40)</td>
<td>15 (34.9)</td>
<td></td>
</tr>
<tr>
<td>Chronic pulmonary disease, n (%)</td>
<td>7 (8.1)</td>
<td>1 (2.4)</td>
<td>15 (14.4)</td>
<td>0.07</td>
</tr>
<tr>
<td>Renal dysfunction, n (%)</td>
<td>14 (11.2)</td>
<td>5 (9.3)</td>
<td>13 (11.0)</td>
<td>0.92</td>
</tr>
<tr>
<td>Peripheral vascular disease, n (%)</td>
<td>18 (20.9)</td>
<td>5 (11.9)</td>
<td>20 (19.2)</td>
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<td>Euroscore, median (range)</td>
<td>4 (0–14)</td>
<td>3.5 (0–10)</td>
<td>5 (0–13)</td>
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<tr>
<td>LVEF, median (range)</td>
<td>55 (20–80)</td>
<td>55 (34–72)</td>
<td>50 (25–74)</td>
<td>0.01</td>
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<tr>
<td>Multivessel disease, n (%)</td>
<td>71 (55.5)</td>
<td>27 (50.0)</td>
<td>64 (57.7)</td>
<td>0.65</td>
</tr>
<tr>
<td>Multivessel treatment, n (%)</td>
<td>33 (31.1)</td>
<td>24 (42.1)</td>
<td>31 (31.9)</td>
<td>0.33</td>
</tr>
<tr>
<td>Glycoprotein IIb–IIIa inhibitors, n (%)</td>
<td>35 (27.3)</td>
<td>20 (33.3)</td>
<td>53 (43.8)</td>
<td>0.02</td>
</tr>
<tr>
<td>Kissing balloon postdilatation, n (%)</td>
<td>98 (76.6)</td>
<td>49 (85.9)</td>
<td>102 (84.3)</td>
<td>0.14</td>
</tr>
</tbody>
</table>

NSTEMI indicates non-ST segment elevation acute myocardial infarction.

capable of guaranteeing the full coverage of the left main carina and of the 2 ostia of the stemming arteries may provide better clinical outcomes. The T-stenting technique cannot always ensure this goal whereas more recent techniques, such as V-stenting or crush stenting may overcome this limitation. In this study, we enrolled a considerable number of patients treated with the 3 most frequently used stent techniques: T-stenting, V-stenting, and crush stenting. No significant differences in terms of mortality, cardiac mortality, MI, and TLR could be observed among the 3 groups of patients. All 3 of these techniques seemed to have a similar safety profile with respect to hard end point, and none was superior to the others in reducing restenosis. Therefore, there seems to be no elements to privilege one technique rather than another when using a 2-stent technique. These findings are not in agreement with a recent study in which patients with distal ULMCA stenosis treated with crush stenting had a poorer outcome than expected in terms of both TLR and harder events such as death an MI. In that study, the efficacy of the crush technique appeared significantly reduced in distal ULMCA stenosis compared with other bifurcated lesions, warning against a routine use of this technique. Moreover, left main was also an independent predictor of MACE also in our study, thus reinforcing the concept that when attempting a bifurcation lesion, especially in the event of left main stenosis, kissing balloon postdilation should be considered mandatory. Moreover, the study by Hoye et al was not intended as a comparison of alternative stenting strategies in the setting of ULMCA stenosis, and therefore, no insight on how these techniques compare with one another in such a peculiar context can be inferred from that study.

**Limits**

This is not a randomized trial. Therefore, the difference in results observed with respect to different stent techniques may depend on different lesion complexity. However, the importance of this study relies in the fact that the stenting strategy carries a prognostic value, a concept that should be taken into account when deciding the strategy of revascularization or comparing outcomes between PCI and surgery. Another limitation of this study was that it was based on a voluntary registry without monitoring or event adjudication. Because baseline angiographic data were not available, we could not assess baseline lesion characteristics, complexity of the anatomy, and possible other factors that drove the technical choice. Another limitation is that we could not assess the incidence of stent thrombosis according to the definition of the Academic Research Consortium. Finally, data on angiographic follow-up were not available and therefore we could not assess the true incidence of restenosis with different stent techniques.

In conclusion, our study suggests that, whenever possible, the 1-stent technique followed by final kissing balloon postdilation should be the preferred strategy to treat distal
ULMCA stenosis. Considering the higher rate of cardiac mortality and MI observed in patients treated with 2 stents compared with patients treated with 1 stent, the double stenting technique should be reserved only in selected cases in which the 1-stent technique is not feasible. When using a 2-stent technique, there seems to be no difference between the treatment approaches.

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Disclosures
None.

References


CLINICAL PERSPECTIVE

One of the major technical challenges for catheter-based treatment of left main stenosis is the bifurcation component of the lesion. The availability of several approaches to treat such lesions raises the question of which is optimal. This study observed that patients treated with 1 stent had not only a significant reduction of target lesion revascularization but also a significant reduction in the adjusted incidence of cardiac mortality and myocardial infarction and suggests that when the anatomy is suitable for single stenting, the 1-stent technique is the preferred approach. Accordingly, whether a patient can be adequately treated with a single stent is also a factor when deciding between percutaneous coronary intervention and bypass surgery.
Impact of Bifurcation Technique on 2-Year Clinical Outcomes in 773 Patients With Distal Unprotected Left Main Coronary Artery Stenosis Treated With Drug-Eluting Stents
Tullio Palmerini, Antonio Marzocchi, Corrado Tamburino, Imad Sheiban, Massimo Margheri, Giuseppe Vecchi, Giuseppe Sangiorgi, Andrea Santarelli, Antonio Bartorelli, Carlo Briguori, Luigi Vignali, Francesco Di Pede, Angelo Ramondo, Luigi Inglese, Marco De Carlo, Giovanni Falsini, Alberto Benassi, Cataldo Palmieri, Vincenzo Filippone, Diego Sangiorgi, Fabio Barlocco and Stefano De Servi

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