Prognostic Value of the Modified American College of Cardiology/American Heart Association Stenosis Morphology Classification for Long-Term Angiographic and Clinical Outcome After Coronary Stent Placement

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Background—The modified American College of Cardiology/American Heart Association (ACC/AHA) lesion morphology criteria are predictive of early outcome after various coronary catheter interventions. Their potential prognostic value after stent implantation and, in particular, for restenosis and long-term clinical outcome has not been studied. We assessed the prognostic value of the modified ACC/AHA criteria for the long-term angiographic and clinical outcome of patients after coronary stenting.

Methods and Results—This study includes 2944 consecutive patients with symptomatic coronary artery disease treated with coronary stent placement. Modified ACC/AHA lesion morphology criteria were used to qualitatively assess the angiograms; type A and B1 lesions were categorized as simple, and type B2 and C lesions were designated complex. Primary end points were angiographic restenosis and 1-year event-free survival. Restenosis rate was 33.2% in complex lesions and 24.9% in simple lesions (P<0.001). It was 21.7% for type A, 26.3% for type B1, 33.7% for type B2, and 32.6% for type C lesions. One-year event-free survival was 75.6% for patients with complex lesions and 81.1% for patients with simple lesions (P<0.001). It was 85.2% for patients with type A, 79.4% for type B1, 75.9% for type B2, and 75.2% type C lesions. The higher risk for restenosis and an adverse outcome associated with complex lesions was also maintained after multivariate adjustment for other clinical and angiographic characteristics.

Conclusions—The modified ACC/AHA lesion morphology scheme has significant prognostic value for the outcome of patients after coronary stent placement. Lesion morphology is able to influence the restenosis process and thus the entire 1-year clinical course of these patients. (Circulation. 1999;100:1285-1290.)

Key Words: stents ♦ thrombosis ♦ restenosis ♦ lesion

The American College of Cardiology/American Heart Association (ACC/AHA) classification system for lesion morphology was intended to assist in the selection of patients most suitable for percutaneous coronary interventions and in the prediction of risk of procedure failure or complications.1,2 Indeed, previous studies have shown more complex lesions to be associated with a lower success rate and/or a higher incidence of complications after PTCA,3 directional atherec-tomy,4 and rotational atherec-tomy.5 Coronary catheter interventions in complex lesions have also been associated with higher costs.6 In addition, the classification system has been useful for evaluating the suitability for PTCA, directional atherec-tomy, rotational ablation, or CABG of patients need-ing coronary revascularization.7,8 Other studies, however, have questioned the value of this classification scheme as a decision-tree element in the selection of the most suitable coronary intervention in a given patient.9,10 At the same time, some studies could not demonstrate a substantial prognostic value for the ACC/AHA grading system.11–13 This role has been found to have vanished, particularly in the era of new devices for catheter interventions.14 We recently demonstrated a sustained predictive power of lesion complexity for the procedural success and early clinical outcome after coronary stent placement.15 Surprisingly, little attention has been paid to the assessment of the influence of lesion complexity according to the ACC/AHA criteria on long-term angiographic and clinical outcome of patients undergoing catheter interventions. A retrospective analysis of the Canadian Coronary Atherectomy trial (CCAT), the design of which excluded type C lesions, found no differences in 6-month angiographic late loss between type A and B lesions treated with either PTCA or atherectomy.9

The objective of this study was to assess, on the basis of prospectively collected data, the prognostic value of lesion complexity for the long-term angiographic and clinical outcome of patients after coronary stent placement.
Methods

Patients
This study includes 2944 consecutive patients with symptomatic coronary artery disease who underwent coronary stent placement in Deutsches Herzzentrum and 1. Medizinische Klinik rechts der Isar der Technischen Universität München. Only patients who were treated with stenting in the setting of acute myocardial infarction were excluded from the study. Stent implantation was the intended procedure for all study patients.

Stent Placement and Poststenting Treatment
The protocol for stent placement and poststenting therapy is described in detail elsewhere.16,17 Various stent types, including Palmaz-Schatz (Johnson & Johnson Interventional Systems Co), Inflow (Inflow Dynamics AG), PURA A (Devon Medical), NIR (a Medinol Ltd product, Scimed Life Systems, Inc), and MULTI-LINK (Guidant, Advanced Cardiovascular Systems, Inc.) were implanted. Most stents were placed hand-crimped on conventional angioplasty balloon catheters.

Angiographic Assessment
Lesions were classified according to the modified ACC/AHA grading system as type A, B1, B2, or C. Left ventricular function was assessed qualitatively on the basis of biplane angiograms with a 7-segment division; the diagnosis of reduced left ventricular function was established when ≥2 segments were hypokinetic. Offline quantitative angiographic analysis was performed with the use of digital angiograms taken in matched views before and immediately after intervention and at follow-up. Both qualitative (including lesion classification) and quantitative analyses were done on the day of intervention by experienced angiographers who were not involved in the procedure and were unaware of patient outcome. The software used was the automated edge-detection system CMS (Medis Medical Imaging Systems). The angiographic parameters obtained were minimal lumen diameter (MLD), interpolated reference diameter, diameter stenosis, lesion length, and diameter of the maximally inflated balloon during the procedure. Acute lumen gain was the difference between final poststenting MLD and preprocedure MLD. Late lumen loss was the difference between final poststenting MLD and MLD at follow-up. Loss index was calculated as the ratio between late lumen loss and acute lumen gain.

Definitions and Follow-Up
Lesions of ACC/AHA type B2 or C were considered complex; those of type A or B1, simple. The absolute number of stents implanted was recorded regardless of length. The length of the stented segment was calculated as the product of stent length and percent stenosis. The procedure was considered successful when stent placement was associated with a residual stenosis of <30% and TIMI flow grade ≥2. Early stent thrombosis was defined as angiographically proven stent vessel occlusion (TIMI flow grade 0 or 1) during the first 30 days after the procedure. Binary restenosis was defined as a diameter stenosis of ≥50% at follow-up angiography. Death of any cause, myocardial infarction, and target vessel revascularization (TVR; PTCA or aortocoronary bypass surgery) were considered major adverse cardiac events. All deaths were considered to be due to cardiac causes unless an autopsy established a noncardiac cause. The diagnosis of myocardial infarction was established in the presence of a clinical episode of prolonged chest pain and a rise in serum creatine kinase (CK) levels to ≥2 times the upper normal limit or the appearance of ≥1 new pathological Q waves on the ECG. Serum CK levels were determined at least once 8 to 24 hours after the intervention regardless of symptoms and whenever a prolonged ischemic episode was suspected during the hospital stay. We also recorded the incidence of non-Q-wave myocardial infarction defined according to the criteria applied in the EPISSENT (EPilogue Stent) trial (a value of CK or its MB isoenzyme of ≥3 times the upper limit).18 TVR was indicated in the presence of angiographic restenosis plus anginal symptoms or objective signs of ischemia. The follow-up protocol included phone contact or a medical visit at the outpatient clinic at 30 days and between 9 and 15 months after stent placement, as well as a control angiography at 6 months. The 6-month angiographic follow-up was scheduled for all patients who had no major adverse cardiac events during the early 30-day period.

Primary end points of the study were angiographic restenosis at 6 months and event-free survival 1 year after intervention. Secondary end points were stent vessel occlusion and adverse clinical events during the first 30 days after the procedure.

Statistical Analysis
Data are expressed as mean±SD or as proportions. Comparisons between patients with complex and those with simple lesions were made with the χ² test for categorical variables and the 2-sided t test for continuous data. The test for trend was used for analyzing categorical data and multiple group ANOVA was used for continuous data among the 4 ACC/AHA types. In addition, for the primary end points of the study, univariate logistic regression analysis (angiographic restenosis) and a Cox regression analysis (survival) were used to calculate the differences in risk between 2 specific ACC/AHA types, accounting for multiple group comparisons. The Kaplan-Meier method and log-rank test were used to compare the 1-year event-free survival rates between various groups. The potential independent role of lesion complexity in late outcome was assessed with multivariate methods. All clinical, angiographic, and procedural variables that differed significantly between the 2 groups in monovariate analysis were entered into the multivariate analysis concomitantly with lesion complexity. Two models were constructed for 2 different outcome variables: a multiple logistic regression model for binary restenosis and a Cox proportional-hazards model for event-free survival. These models allowed calculation of the adjusted risk of restenosis (odds ratio [OR] and 95% CI from logistic regression analysis) and 1-year adverse outcome (hazard ratio and 95% CI from Cox analysis) associated with lesion complexity. Statistical significance was accepted for values of P<0.05.

Results

Patient Characteristics
There were 264 patients with type A lesions, 634 with type B1, 1152 with type B2, and 894 with type C. Main baseline characteristics of the patients are listed in Tables 1 and 2. Patients with complex lesions were older; were more likely to be men; and more frequently had unstable angina, reduced left ventricular function, multivessel disease, and more severe stenosis. Patients with complex lesions were treated by use of a higher balloon pressure and a larger number of stents and presented more frequently with overlapping stents and uncovered residual dissections at the end of the procedure. The procedure was successful in 97.6% of patients with complex lesions and 98.9% of those with simple lesions (P=0.02). Of the 2824 patients eligible for 6-month angiographic follow-up, 2296 patients (81%) had control angiography at a median of 187 days (interquartile range, 167 to 203 days) after the procedure. The rate of angiographic follow-up was not associated with lesion complexity; it was 82% in patients with complex lesions and 80% in those with simple lesions (P=0.2). Patients who failed to have angiographic restudy were less likely to have restenotic lesions (P<0.001) and had shorter lesions (P=0.04) at baseline than patients who underwent follow-up angiography, all other clinical, angiographic, and procedural characteristics being similar.

Early (30-Day) Outcome
Stent vessel occlusion occurred more often in complex lesions (2.7% versus 1.3% in simple lesions, P=0.02). It
occurred in 0.8% of type A lesions, 1.6% of type B1, 1.7% of type B2, and 3.9% of type C (P<0.001, test for trend). The incidence of death was 1.2% in patients with complex lesions and 0.7% in those with simple lesions (P=0.21). Nonfatal Q-wave myocardial infarction was observed in 1.4% of patients with complex and 0.6% of patients with simple lesions (P=0.04). On the basis of CK determinations during the first 24 hours after procedure (single determination in 1424 patients and serial determinations every 8 hours in 1520), the incidence of non–Q-wave myocardial infarction was 4.4% in patients with complex and 2.2% in those with simple lesions (P=0.004). The combined event rate of death, Q-wave myocardial infarction, or TVR was 4.7% in patients with complex and 2.2% in those with simple lesions (P=0.01). More specifically, it was 2.6% in patients with type A lesions, 2.7% in type B1, 3.7% in type B2, and 6.0% in type C (P<0.001, test for trend).

**Late Outcome**

Table 3 shows the quantitative results of the 6-month angiographic follow-up. All parameters of lumen renarrowing were significantly less favorable in complex lesions. Restenosis rate was 33.2% in complex lesions and 24.9% in simple lesions (P<0.001). It was 21.7% for type A lesions, 26.3% for type B1, 33.7% for type B2, and 32.6% for type C (P<0.001, test for trend). Similarly, the proportion of treated lesions found totally occluded at follow-up angiography increased significantly with the increase in lesion complexity: 1.5% in type A lesions, 2.4% in type B1, 4.3% in type B2, and 3.9% in type C (P=0.048, test for trend). Late lumen loss was also greater in complex lesions (P<0.001, Figure 1). It was 0.90±0.72 mm for type A lesions, 1.03±0.74 mm for type B1, 1.20±0.85 mm for type B2, and 1.17±0.81 mm for type C (P<0.001).

All variables for which univariate analysis yielded a significant difference (age, sex, unstable angina, reduced left ventricular function, multivessel disease, vessel location, abrupt closure before stenting, preprocedural diameter stenosis and lesion length, balloon pressure, number of stents, stented length, stent overlap, and large residual dissection) were entered into the multivariate logistic model as potential predictors of restenosis along with lesion complexity. The presence of complex lesions was associated with a 33% independent risk increase for restenosis (OR, 1.33; 95% CI, 1.07 to 1.64; P=0.009). Other significant independent risk factors for restenosis were lesion location in left anterior descending (P=0.008) or left circumflex (P=0.006) coronary artery, a tighter (P<0.001) and longer (P=0.03) stenosis before intervention, a greater number of stents implanted (P=0.02), and the presence of stent overlap (P=0.002). The independent predictive value of lesion complexity was further potentiated (P=0.004) when we included vessel size (P<0.001) in the multivariate model.

Event-free survival (free of myocardial infarction or TVR) at 1 year was 75.6% for patients with complex lesions and 81.1% for patients with simple lesions (P<0.001; Figure 2). All variables mentioned above for the model of restenosis were entered into the Cox model for event-free survival. The presence of complex lesions was associated with a 27% independent risk increase for an adverse outcome (hazard ratio, 1.27; 95% CI, 1.06 to 1.52; P=0.01). Other significant independent risk factors for an adverse outcome were lesion location in left anterior descending (P=0.03) or left circumflex (P=0.02) coronary artery and a tighter (P=0.006) and longer (P=0.002) stenosis before intervention. According to the specific ACC/AHA type, event-free survival was 85.2% for patients with type A lesions, 79.4% for type B1, 75.9% for type B2, and 75.2% for type C (P=0.003). Patients with complex lesions showed a trend to decreased survival free of myocardial infarction compared with patients with simple lesions (94.1% versus 95.5%, P=0.11). The 1-year risk of death of any cause was 3.7% for patients with complex lesions and 3.6% for patients with simple lesions; mortality caused by noncardiac causes was 0.9% in both groups. Regardless of lesion complexity, the 1-year mortality rate was 25% among those who incurred a Q-wave myocardial infarction during the first 30 days after stenting, 13.6% in those with non–Q-wave myocardial infarction, and 2.9% among patients without myocardial infarction as an early complication (P<0.001). The frequency of TVR was 20.7% in patients with complex lesions and 15.4% in those with simple lesions (P<0.001). It was 11.4% for type A lesions, 17.0% for type B1, 20.7% for type B2, and 20.6% for type C (P<0.001, test for trend). In patients who underwent TVR, restenosis sever-

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**Table 1. Baseline Clinical Characteristics of Patients According to Lesion Complexity**

<table>
<thead>
<tr>
<th></th>
<th>Complex Lesions (n=2046)</th>
<th>Simple Lesions (n=898)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, y (mean±SD)</td>
<td>64.1±10.4</td>
<td>63.1±10.6</td>
<td>0.017</td>
</tr>
<tr>
<td>Women, %</td>
<td>22.3</td>
<td>25.7</td>
<td>0.042</td>
</tr>
<tr>
<td>Hypertension, %</td>
<td>66.8</td>
<td>68.7</td>
<td>0.313</td>
</tr>
<tr>
<td>Diabetes, %</td>
<td>21.2</td>
<td>20.2</td>
<td>0.536</td>
</tr>
<tr>
<td>Smoking, %</td>
<td>29.7</td>
<td>31.7</td>
<td>0.272</td>
</tr>
<tr>
<td>Hypercholesterolemia, %</td>
<td>40.3</td>
<td>38.6</td>
<td>0.478</td>
</tr>
<tr>
<td>Unstable angina, %</td>
<td>39.6</td>
<td>32.3</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Reduced left ventricular function, %</td>
<td>42.7</td>
<td>36.1</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Multivessel disease, %</td>
<td>71.7</td>
<td>64.8</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Antiplatelet therapy after stenting, %</td>
<td>82.4</td>
<td>84.4</td>
<td>0.182</td>
</tr>
</tbody>
</table>
ity was comparable to that of the original lesion, with diameter stenosis of 75.4±16.5% at follow-up angiography compared with 75.6±14.3% before initial stent placement procedure (P=0.83). In addition, in patients with complex lesions, TVR was carried out in the presence of more severe restenosis than in patients with simple lesions, with diameter stenoses of 76.4±15.6% and 72.4±19.1%, respectively (P=0.03).

### TABLE 2. Lesion and Procedural Characteristics of Patients According to Lesion Complexity

<table>
<thead>
<tr>
<th></th>
<th>Complex Lesions (n=2046)</th>
<th>Simple Lesions (n=898)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target vessels, %</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Left main</td>
<td>2.1</td>
<td>1.2</td>
<td></td>
</tr>
<tr>
<td>LAD</td>
<td>41.9</td>
<td>43.1</td>
<td></td>
</tr>
<tr>
<td>LCx</td>
<td>17.0</td>
<td>20.8</td>
<td></td>
</tr>
<tr>
<td>RCA</td>
<td>30.5</td>
<td>33.5</td>
<td></td>
</tr>
<tr>
<td>Venous bypass graft</td>
<td>8.5</td>
<td>1.4</td>
<td></td>
</tr>
<tr>
<td>Restenotic lesions, %</td>
<td>13.7</td>
<td>14.7</td>
<td>0.465</td>
</tr>
<tr>
<td>Acute vessel closure before stenting, %</td>
<td>3.6</td>
<td>1.3</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

Before stenting

<table>
<thead>
<tr>
<th></th>
<th>Complex Lesions</th>
<th>Simple Lesions</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reference diameter, mm</td>
<td>3.05±0.52</td>
<td>3.02±0.53</td>
<td>0.269</td>
</tr>
<tr>
<td>MLD, mm</td>
<td>0.73±0.47</td>
<td>0.88±0.48</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Diameter stenosis, %</td>
<td>76.1±14.5</td>
<td>71.3±14.2</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Lesion length, mm</td>
<td>11.3±5.9</td>
<td>10.1±5.2</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

Procedural data

<table>
<thead>
<tr>
<th></th>
<th>Complex Lesions</th>
<th>Simple Lesions</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximal balloon pressure, atm</td>
<td>13.9±3.3</td>
<td>13.4±3.2</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Balloon-to-vessel ratio</td>
<td>1.07±0.11</td>
<td>1.06±0.11</td>
<td>0.191</td>
</tr>
<tr>
<td>Type of stent</td>
<td></td>
<td></td>
<td>0.253</td>
</tr>
<tr>
<td>Palmaz-Schatz</td>
<td>49.0</td>
<td>45.1</td>
<td></td>
</tr>
<tr>
<td>Inflow</td>
<td>22.1</td>
<td>23.6</td>
<td></td>
</tr>
<tr>
<td>PURA A</td>
<td>13.6</td>
<td>13.5</td>
<td></td>
</tr>
<tr>
<td>NIR</td>
<td>8.4</td>
<td>9.9</td>
<td></td>
</tr>
<tr>
<td>MULTI-LINK</td>
<td>4.4</td>
<td>5.7</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>2.5</td>
<td>2.2</td>
<td></td>
</tr>
<tr>
<td>Number of stents</td>
<td>1.83±1.23</td>
<td>1.39±0.81</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Stented segment length, mm</td>
<td>19.7±12.3</td>
<td>14.9±8.3</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Stent overlap, n</td>
<td>21.9</td>
<td>15.4</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

Immediately after stenting

<table>
<thead>
<tr>
<th></th>
<th>Complex Lesions</th>
<th>Simple Lesions</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large residual dissections, n</td>
<td>4.0</td>
<td>1.2</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>MLD, mm</td>
<td>2.92±0.53</td>
<td>2.88±0.48</td>
<td>0.060</td>
</tr>
<tr>
<td>Diameter stenosis, %</td>
<td>5.9±10.8</td>
<td>6.2±9.2</td>
<td>0.567</td>
</tr>
</tbody>
</table>

LAD indicates left anterior descending artery; LCx, left circumflex artery; and RCA, right coronary artery. Values are mean±SD when appropriate.

### TABLE 3. Angiographic Characteristics at Follow-Up

<table>
<thead>
<tr>
<th></th>
<th>Complex Lesions (n=1598)</th>
<th>Simple Lesions (n=698)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>MLD, mm</td>
<td>1.76±0.91</td>
<td>1.90±0.85</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Diameter stenosis, %</td>
<td>42.9±26.7</td>
<td>37.5±24.5</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Late lumen loss, mm</td>
<td>1.19±0.83</td>
<td>0.99±0.73</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Loss index</td>
<td>0.56±0.41</td>
<td>0.52±0.42</td>
<td>0.017</td>
</tr>
<tr>
<td>Restenosis rate, %</td>
<td>33.2</td>
<td>24.9</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Total occlusions</td>
<td>4.1</td>
<td>2.2</td>
<td>0.018</td>
</tr>
<tr>
<td>Stenoses</td>
<td>29.1</td>
<td>22.7</td>
<td>0.002</td>
</tr>
</tbody>
</table>

Values are mean±SD when appropriate.

**Figure 1.** Late lumen loss at follow-up angiography in patients with complex lesions and in those with simple lesions.
Table 4 summarizes the results of paired comparisons among ACC/AHA types accounting for multiple groups. It shows that significant risk differences are confined to the comparisons between type C and B2 lesions on 1 side and type A and B1 lesions on the other side.

Table 4. Paired Comparisons of Risk for Restenosis Among Lesion Morphology Types*

<table>
<thead>
<tr>
<th>Type</th>
<th>B1</th>
<th>B2</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1.29 (0.87–1.90)</td>
<td>1.84 (1.28–2.64)</td>
<td>1.75 (1.21–2.53)</td>
</tr>
<tr>
<td>B1</td>
<td>1.43 (1.12–1.82)</td>
<td>1.36 (1.05–1.75)</td>
<td>0.95 (0.77–1.17)</td>
</tr>
</tbody>
</table>

*OR (95% CI) for comparison between lesion type in column and lesion type in row.

Lesion Morphology and Early Outcome

In 350 patients, Ellis et al.3 found a steady increase in complication rate with higher grades of lesion complexity. It was 2.4% for type A lesions, 8% for type B1, 10% for type B2, and 17.5% for type C.3 Our 30-day results relative to the complication rate with higher grades of lesion complexity. It shows that significant risk differences are confined to the comparisons between type C and B2 lesions on 1 side and type A and B1 lesions on the other side.

Discussion

The present study demonstrates that the modified ACC/AHA lesion morphology classification system has significant independent prognostic value for the outcome of patients after coronary stent placement. Interestingly, lesion complexity influenced not only the early but also the long-term outcome through its negative impact on restenosis.

Lesion Morphology and Late Outcome

This study demonstrates for the first time the protraction of the influence of lesion morphology on outcome beyond the first month after coronary stent implantation. Event-free survival was significantly lower in patients with complex lesions even after controlling for other risk factors. It is reassuring that the combined incidence of death and myocardial infarction in patients with complex lesions was not significantly higher than that verified for patients with simple lesions. Thus, our data may not refute the usefulness of stenting in the presence of lesions with more complex morphology. Most of the difference in event-free survival between the groups with complex and simple lesions was produced by a more frequent need of TVR in patients with complex lesions. This is to be attributed to the higher restenosis rate in this group of patients. Intravascular ultrasound studies have found that plaque burden before intervention was a powerful risk factor for restenosis,19 and plaque burden is expected to be greater in complex lesions. We found significant differences between type B2 and B1 lesions, which indicate that type B as originally defined in the ACC/AHA criteria1 contains 2 distinct groups of lesions with different risks for restenosis. Therefore, our findings constitute further support for the modification made to the ACC/AHA scheme. Although there was a stepwise increase in early event rates as lesion complexity went from type A to C, significant differences in long-term outcome measures were seen mostly between 2 groups of lesions composed of types A and B1 and types B2 and C. Thus, for simplicity, the 4 types of the modified ACC/AHA classification scheme can be further condensed into 2 types, simple and complex lesions, in the same way that was used often in this study to present the results. The findings of our study relative to the significant association between lesion complexity and long-term outcome after coronary stent placement legitimize the recommendation that modified ACC/AHA criteria should become integral part of the list of factors that serve for risk assessment of patients undergoing coronary stent placement.

Study Limitations

Although all data were prospectively collected with the objective of assessing the potential association between lesion complexity and long-term outcome after stenting, the study lacks a fully prospective design with a well-defined prior hypothesis, and this should be considered a limitation. In addition, 20% of patients equally distributed between our
study groups failed to undergo angiographic follow-up. The complete 1-year clinical follow-up achieved in this study, however, may attenuate the limitation caused by this level of missing angiographic restudy. Conventional angioplasty, with or without intracoronary stents, remains the dominant treatment strategy in current coronary interventional practice. The major limitation of the present study lies in the fact that while providing evidence about the importance of lesion morphology in determining the early and long-term outcome after coronary stent placement, it is a mono-device study that does not offer direct help for defining the best interventional strategy for complex lesions. Randomized studies have already proven the advantages of stenting over plain PTCA for the treatment of patients with coronary artery disease, but the results were confined primarily to relatively simple lesions. The present study further underscores the need to compare stenting with other catheter interventions, especially conventional PTCA, for the treatment of patients with complex lesions. Interpretation of the results of the present study should also take into account the interobserver and intraobserver variabilities in grading of coronary lesions according to ACC/AHA criteria.

Conclusions

This study demonstrates that the modified ACC/AHA lesion morphology scheme has significant prognostic value for outcome after coronary stent placement. This value is not confined to the early postinterventional period only. Lesion morphology is able to influence the restenosis process and thus the entire 1-year clinical course of patients treated with intracoronary stenting. Therefore, the modified ACC/AHA grading system should be considered a useful prognostic index for risk assessment in patients undergoing coronary stent placement.

References


Prognostic Value of the Modified American College of Cardiology/American Heart Association Stenosis Morphology Classification for Long-Term Angiographic and Clinical Outcome After Coronary Stent Placement
Adnan Kastrati, Albert Schömig, Shpend Elezi, Josef Dirschinger, Julinda Mehilli, Helmut Schühlen, Rudolf Blasini and Franz-Josef Neumann

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