Risks of Noncardiac Surgery After Coronary Stenting

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An increased risk of major complications for noncardiac surgery after coronary stenting has been suggested. We retrospectively reviewed all cases of coronary stents from 1999 to 2003 with subsequent surgery to assess major adverse cardiovascular events (MACEs), including myocardial infarction, stent thrombosis, major bleeding, and death. Among the 56 patients identified, 8 developed MACEs; 38% underwent surgery ≤14 days after stenting, and 62% underwent surgery 15 to 42 days after stenting. No patient developed MACEs if surgery occurred >42 days after stenting. Among patients who developed MACEs, 77% of surgeries were elective, 19% were urgent, and only 4% were emergency. Noncardiac surgery 6 weeks after coronary stenting is associated with a high risk of MACEs. ©2005 by Excerpta Medica Inc.

Because most percutaneous coronary interventions entail stenting, recent reports of increased risk of in-stent thrombosis or major bleeding with noncardiac surgery in patients who have recently received stents are a cause for concern. These reports were based on limited numbers of patients and the period of increased risk after stenting has not been fully elucidated. The primary aim of our study was to more fully characterize the magnitude and temporal dimensions of the risk of major adverse cardiovascular events (MACEs) in patients who undergo noncardiac surgery after coronary stenting.

This was a retrospective study of all patients who underwent coronary stenting and subsequent noncardiac surgery at the University of Illinois at Chicago Medical Center from 1999 to 2004. We collected data on anticoagulation, type of surgery, urgency of surgery, cardiac risk factors, previous myocardial infarction (MI), and left ventricular function. We collected data on the type, number, and size of stents. Drug-eluting stents were not included in this study.

MACEs were defined as MI or cardiovascular death. MI was defined as new pathologic Q waves in ≥2 contiguous leads, ST elevation >1 mm in ≥2 contiguous leads, increased creatinine kinase-MB or troponin >2 times the upper limit of normal, a new significant wall motion abnormality on left ventricular imaging, or angiographic demonstration of stent thrombosis. A MI was considered related to stenting if a stent thrombosis was demonstrated angiographically or if the MI involved the stented territory. If a nonstented artery was demonstrated angiographically to be the culprit artery or the infarct involved a territory remote from the stented vessel, the MI was not attributed to the stent. Major bleeding episodes were defined by a need for surgical reexploration, transfusion of ≥2 U of packed red blood cells, a decrease in hemoglobin of ≥2 g/dl, or intracranial, intracoarcal, or retroperitoneal bleeding. Bleeding was attributed to stent-related antiplatelet therapy if the patient had been receiving aspirin and thienopyridine ≤5 days before surgery. Bleeding that occurred >5 days after discontinuation of clopidogrel or ticlopidine was considered unrelated to the antiplatelet regimen required for stents. Death was characterized according to primary and contributing causes of death. MI or bleeding was considered to be the primary cause of death if the MI or bleeding was the first major untoward event after noncardiac surgery.

Statistical analysis included constructing a table of cumulative incidence. We then compared the incidence of MACEs across patients in whom the delay from stenting to surgery was 0 to 14 days, 15 to 42 days, and >42 days. Comparison of clinical with angiographic characteristics across these 3 temporally defined groups included analysis of variance for continuous variables and chi-square test for categorical variables. To elucidate the influence of timing of surgery and baseline characteristics, we performed a multivariate analysis with the occurrence of MACE as the dependent variable and the delay until surgery and baseline characteristics as the independent variables.

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We identified 56 patients who underwent noncardiac surgery after placement of a coronary stent. Demographic, clinical, and procedural characteristics are presented in Table 1. Before percutaneous coronary intervention, 21% of the study population received glycoprotein IIb/IIIa inhibitors and 14% received heparin. After stenting, 98% of patients were discharged on aspirin and 96% were discharged on clopidogrel. After stenting, 98% of patients were discharged on aspirin and 32% were taking clopidogrel. Therefore, it is evident that, in patients who underwent surgery after coronary stenting, antiplatelet therapy after stenting may be unable to prevent in-stent thrombosis when the patient is exposed to the thrombogenic stimulus of surgery. Conversely, several patients developed major bleeding after undergoing surgery while being treated with aspirin and clopidogrel. Therefore, it is evident that, in patients who undergo surgery after coronary stenting, the dual antiplatelet regimen may fail to protect against thrombosis and expose the patient to bleeding risk. The bleeding risk associated with clopidogrel has been documented in other surgical settings. Although some studies have suggested that a shorter period of thienopyridine therapy may suffice, such observations may have contributed to the initial view that deferral of noncardiac surgery for 2 weeks would suffice.

Our study corroborates previous reports of an increased risk of MACEs associated with noncardiac surgery after coronary stenting.2-4 We support these observations in identifying that the period of increased risk is ≥6 weeks in duration. The standard duration of dual antiplatelet therapy after stenting is generally 4 weeks,5-9 although some studies have suggested that a shorter period of thienopyridine therapy may suffice.10 Such observations may have contributed to the view that deferral of noncardiac surgery for 2 weeks would suffice.

A significant portion of thrombosis-driven events in our study occurred despite the continuation of aspirin and clopidogrel, suggesting that even appropriate antiplatelet therapy after stenting may be unable to prevent in-stent thrombosis when the patient is exposed to the thrombogenic stimulus of surgery. Conversely, several patients developed major bleeding after undergoing surgery while being treated with aspirin and clopidogrel. Therefore, it is evident that, in patients who undergo surgery after coronary stenting, the dual antiplatelet regimen may fail to protect against thrombosis and expose the patient to bleeding risk. The bleeding risk associated with clopidogrel has been documented in other surgical settings.11,12 The irreversible effects of clopidogrel on platelets further complicates the management of these patients. In the era of drug-eluting stents, the time required to reen-
dothelialize a stent may be extended and require further delay before proceeding to surgery.

Our data further confirm the high mortality rate associated with stent-related MACEs or major bleeding ≤6 weeks of a procedure. In-stent thrombosis has been shown to have a high mortality rate in general and should be avoided in the postoperative period of elective surgery.


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**In-Hospital and Nine-Month Outcome of Treatment of Coronary Bifurcational Lesions With Sirolimus-Eluting Stent**

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Between April 2002 and May 2004, 174 consecutive patients who underwent percutaneous coronary intervention of bifurcational lesions with sirolimus-eluting stents were identified. Two strategies were used: stenting only 1 branch (group 1S, n = 57) or stenting both branches (group 2S, n = 117). The incidence of major adverse cardiac events was evaluated in the hospital and at 9-month follow-up. There were no statistically significant differences between the 2 groups with regard to the incidence of target lesion revascularization (5.4% vs 8.9%, p = 0.76), target vessel revascularization (5.4% vs 11.1%, p = 0.51), and cumulative major adverse cardiac events (18.9% vs 23.3%, p = 0.76) at 9 months. ©2005 by Excerpta Medica Inc.

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**TABLE 1 Baseline Clinical Characteristics**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Group 1S (n = 57)</th>
<th>Group 2S (n = 117)</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yrs)</td>
<td>61 ± 12</td>
<td>63 ± 12</td>
<td>0.52</td>
</tr>
<tr>
<td>current or ex-smoker</td>
<td>29 (51%)</td>
<td>63 (54%)</td>
<td>0.84</td>
</tr>
<tr>
<td>Hypercholesterolemia (mg/dl)</td>
<td>38 (67%)</td>
<td>79 (68%)</td>
<td>1.0</td>
</tr>
<tr>
<td>Hypertension (mm Hg)</td>
<td>42 (74%)</td>
<td>75 (64%)</td>
<td>0.28</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>16 (28%)</td>
<td>18 (15%)</td>
<td>0.07</td>
</tr>
<tr>
<td>Previous myocardial infarction</td>
<td>31 (54%)</td>
<td>45 (39%)</td>
<td>0.05</td>
</tr>
<tr>
<td>Previous coronary bypass</td>
<td>5 (9%)</td>
<td>18 (15%)</td>
<td>0.33</td>
</tr>
<tr>
<td>Unstable angina pectoris</td>
<td>15 (26%)</td>
<td>27 (23%)</td>
<td>0.18</td>
</tr>
<tr>
<td>Left ventricular ejection fraction</td>
<td>52 ± 4</td>
<td>52 ± 9</td>
<td>1.0</td>
</tr>
<tr>
<td>Glycoprotein Iib/Illa inhibitors</td>
<td>20 (35%)</td>
<td>62 (53%)</td>
<td>0.04</td>
</tr>
</tbody>
</table>

Values are expressed as number (percent) or mean ± SD.

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Percutaneous treatment of coronary bifurcational lesions represents a challenging area in interventional cardiology.1,2 Restenosis at the ostium of the side branch was a problem, possibly due to incomplete coverage of the ostium with the stent. To improve this limitation, 2 different stent techniques were introduced.3–7 However, stenting of both branches pro-

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