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The Incremental Risk of Noncardiac Surgery on Adverse Cardiac Events Following Coronary Stenting

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ABSTRACT

BACKGROUND Recent coronary stent placement and noncardiac surgery contribute to the risk of adverse cardiac events, but the relative contributions of these two factors have not been quantified.

OBJECTIVES This research was designed to determine the incremental risk of noncardiac surgery on myocardial infarction (MI) and coronary revascularization following coronary stenting.

METHODS A U.S. retrospective cohort study of patients receiving coronary stents at Veterans Affairs medical centers between 2000 and 2010 was used to match patients undergoing noncardiac surgery within 24 months of stent placement to two patients with stents not undergoing surgery. Patients were matched on stent type and cardiac risk factors present at the time of stent placement. A composite endpoint of MI and/or cardiac revascularization for the 30-day interval post-surgery was calculated. Adjusted risk differences (RD) were compared across time periods following stent implantation, using generalized estimating equations.

RESULTS We matched 20,590 surgical patients to 41,180 nonsurgical patients. During the 30-day interval following noncardiac surgery, the surgical cohort had higher rates of the composite cardiac endpoint (3.1% vs. 1.9%; RD: 1.3%; 95% confidence interval: 1.0% to 1.5%). The incremental risk of noncardiac surgery adjusted for surgical characteristics ranged from 3.5% immediately following stent implantation to 1% at 6 months, after which it remained stable out to 24 months. Factors associated with a significant reduction in risk following surgery more than 6 months post-stent included elective inpatient procedures (ΔRD: 1.8%; $p = 0.01$), high-risk surgery (ΔRD: 3.7%; $p = 0.01$), and drug-eluting stent (DES) (ΔRD: 1.3%; $p = 0.01$).

CONCLUSIONS The incremental risk of noncardiac surgery on adverse cardiac events among post-stent patients is highest in the initial 6 months following stent implantation and stabilizes at 1.0% after 6 months. Elective, high-risk, inpatient surgery, and patients with DES may benefit most from delay from a 6-month delay after stent placement. (J Am Coll Cardiol 2014;64:2730–9) © 2014 by the American College of Cardiology Foundation.

The prevalence of surgical intervention within the 2 years following coronary stent implantation in the U.S. is estimated between 12% and 23% (1–3). Patients with recent coronary stent placement undergoing noncardiac surgery are at increased risk for adverse cardiac events (4–7). The adverse events are partly due to a combination of a patient's cardiac disease and the body's stress

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response to surgery. Important cardiac drivers of adverse event risk include a history of ischemic heart disease, congestive heart failure, and the time between coronary stent implantation and the surgery (2,8,9), while surgical factors implicated include urgency and complexity of the surgical procedure (4). However, the relative contribution of these cardiac and surgical factors to overall postoperative risk, and whether risk changes over time following stenting, are currently unknown. Understanding these contributions to risk would allow for more tailored, effective mitigation strategies, such as antiplatelet and statin therapies to minimize exacerbations of cardiac disease, as well as stable hemodynamic control and postoperative analgesia to minimize the stress of surgery (10). Additionally, the knowledge of which surgical characteristics are associated with the highest risk, especially in the early post-stent period, would improve pre-operative risk assessment and perioperative anesthesia management.

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To estimate the relative contributions of surgical and cardiac factors to perioperative adverse cardiac events, we compared event rates in a cohort of post-stent patients undergoing noncardiac surgery to those in a matched cohort of post-stent patients not undergoing surgery to determine the incremental effect of surgery on perioperative events. In addition, we conducted analyses exploring the effect of time between coronary stent implantation and surgery on postoperative cardiac events and determined how this risk differs by surgical procedure type.

METHODS

STUDY DESIGN AND DATA SOURCES. We performed a matched retrospective cohort study to assess the incremental risk of surgery on postoperative adverse cardiac events following coronary stent implantation. Patients with a coronary stent implanted at Veterans Affairs (VA) medical centers between October 1, 1999, and September 30, 2009, were identified in the VA Patient Treatment Files by International Classification of Diseases-Ninth Edition (ICD-9) procedure codes of 36.06 for bare-metal stent (BMS) or 36.07 for drug-eluting stent (DES). Following the identification of the study cohort, information on noncardiac procedures in the 24 months following coronary stent implantation was obtained from the VA National Surgery Office and the Centers for Medicaid & Medicare Services. Noncardiac surgery was defined by CPT codes, and detailed information on the construction of the study cohort and study variables has been previously published (4). Admission status was defined as elective if a patient was admitted to the hospital from home, and all other admission sources were considered nonelective.

STUDY POPULATION. We compared all patients with coronary stents undergoing noncardiac surgery in the 24 months following stent implantation to patients with coronary stents not undergoing subsequent surgery. Each patient undergoing surgery was matched to two patients who did not undergo surgery. Matching was on the basis of patient age, race, stent type (BMS or DES), year of stent placement, each of the six variables included in the revised Cardiac Risk Index (RCRI) (9), and those identified in our previous analyses as significant predictors of major adverse cardiac events, including myocardial infarction (MI) 6 months prior to stent implantation and peripheral vascular disease (4). Patients in the nonsurgical cohort were required to be alive during the time interval following stent placement when their matched counterpart underwent surgery. That is, if a surgical patient had surgery 200 days following stent placement, their two matched nonsurgical patients had to be alive for at least 200 days following their stent placements.

OUTCOME VARIABLES. Our primary outcome was a composite endpoint of acute MI and/or coronary revascularization by percutaneous coronary intervention or coronary artery bypass grafting within 30 days following surgery in the surgical cohort or the equivalent post-stent time period for the nonsurgical cohort. We did not include all-cause mortality in our composite endpoint as the cohorts were not matched on probability of death at the time of stent placement. We excluded patients from the study who underwent surgery within 2 weeks following coronary stent placement as it was difficult to attribute an MI to surgery versus an MI associated with receiving a coronary stent on the basis of administrative data.

ANALYTICAL METHODS. Assessment of the matched cohort. The matched cohort was compared by univariate and bivariate frequencies to describe patient characteristics and the composite outcome of adverse cardiac events. Bivariate frequencies were compared using chi-square tests and continuous variables were compared using Wilcoxon rank-sum tests. To ensure effective matching on cardiac event outcomes, we calculated the cumulative risk of the composite cardiac endpoint using Kaplan-Meier survival curves comparing time to first outcome by cohort and by stent type.

Assessment of the incremental risk of noncardiac surgery. To determine the incremental risk of surgery on adverse cardiac events, we estimated the risk difference for adverse events in the 30 days following

ABBREVIATIONS AND ACRONYMS

BMS = bare-metal stent(s)
DES = drug-eluting stent(s)
MI = myocardial infarction
RCRI = revised Cardiac Risk Index
RD = risk difference