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EDITORIAL COMMENT

What to Do When a Patient With Coronary Stents Needs Surgery?*

Emmanouil S. Brilakis, MD, PhD,† George D. Dangas, MD, PhD‡

Patients who undergo surgery after coronary stent implantation are at risk for perioperative stent thrombosis, a highly morbid complication that can be particularly challenging to treat because the often necessary antithrombotic medications markedly increase the risk for bleeding at the surgical site (1,2).

In a landmark study of >40,000 patients, Hawn et al. (3) previously identified 3 major factors associated with perioperative major adverse cardiac events when noncardiac surgery is performed within 2 years of stenting: 1) nonelective surgical admission; 2) history of myocardial infarction in the 6 months preceding surgery; and 3) revised Cardiac Risk Index higher than 2. Timing of surgery after stenting ranked fifth in explanatory importance, and the risk was similar regardless of stent type—drug-eluting (DES) or bare-metal stent. The obvious clinical dilemma is the selective interruption of the dual antiplatelet therapy in a way that surgery would have acceptable bleeding risk while minimizing the risk for stent thrombosis.

In this issue of the *Journal*, Holcomb et al. (4) provide additional, novel information on the incremental risk of noncardiac surgery on myocardial infarction and coronary revascularization following surgery. After matching 20,590 surgical to 41,180 nonsurgical stent patients, the incremental risk for adverse cardiac events with noncardiac surgery, adjusted for surgical characteristics, was 2.8% during the first 6 weeks, 2.0% between 6 weeks and 6 months, and 0.9% after 6 months to 24 months, driven by differences in myocardial infarction and death. There are important "take-home" messages from this study, in more than one aspect of this complex clinical problem.

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First, it confirms that the first 6-weeks post-coronary stenting is the highest risk period for perioperative complications, as suggested by a prior study (5). Approximately 1 in 10 patients undergoing surgery within 6 weeks from stenting had a major adverse cardiac event, and the major adverse cardiac event was related to stenting in 1 of 36 patients (4). Therefore, stenting should be avoided if at all possible in patients known to require noncardiac surgery within 6 weeks. Medical therapy would be the best option, with deferral of stenting until after noncardiac surgery. If revascularization is absolutely necessary (e.g., in patients with acute coronary syndromes and unstable symptoms or left main disease) for extensive multivessel disease, then coronary artery bypass graft surgery would be preferred, if technically and clinically feasible/appropriate (2). If percutaneous coronary intervention is performed, an attempt to achieve a good result with balloon angioplasty alone might be preferable, as the risk for perioperative complications appears to be low after 2 weeks (6). If noncardiac surgery is performed early after stenting, consideration should be given to perioperative continuation of oral antiplatelet therapy (3) (at least aspirin if $P2Y_{12}$ inhibitor discontinuation is mandated), or pre-operative "bridging" with a glycoprotein IIb/IIIa inhibitor (7,8), although there

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From the †VA North Texas Healthcare System and University of Texas Southwestern Medical Center at Dallas, Dallas, Texas; and the ‡Mount Sinai Medical Center, New York, New York. Dr. Brilakis has received honoraria for serving on the speakers bureaus of and consulting for Abbott Vascular, Asahi, Boston Scientific, Elsevier, Janssen Therapeutics, Somahlution, St. Jude Medical, and Terumo; has received research support from Guerbet; and his spouse is an employee of Medtronic. Dr. Dangas has been a member of the scientific advisory board for Abbott Vascular; and his spouse has been a member of the scientific advisory boards for Abbott Vascular, Boston Scientific, Bristol-Myers Squibb, and Sanofi.

are limited data to support either approach. In a recent report from a large international registry, a physician-driven, careful risk stratification and selective interruption of dual antiplatelet therapy were found to be more frequent than expected and safer than anticipated (9).

Second, it demonstrates that the risk for major adverse cardiac events remains elevated between 6 weeks and 6 months from stenting (1 in 20 patients had a major adverse cardiac event, which was related to stenting in 1 of 50 patients), and plateaus thereafter. The 2014 American College of Cardiology/American Heart Association perioperative management guidelines recommend delaying surgery for at least 12 months after DES implantation (Class I recommendation), yet suggest that 6 months may be enough "if the risk of further delay is greater than the expected risks of ischemia and stent thrombosis" (Class IIb recommendation) (10). This study by Holcomb et al. (4), which supports the latter recommendation, is in line with another study showing that a shorter duration of dual antiplatelet therapy after stenting may provide similar (or better) outcomes compared with a longer duration (11). A similar plateau of clinical events in relation to antiplatelet therapy interruption also was reported beyond 6 months (12).

Third, after 6 months the incremental risk stabilized at approximately 1%, but continued out to at least 24 months, and perhaps longer (13). This is in agreement with a systematic review in which the risk of perioperative stent thrombosis was 0.86% when surgery was performed after 12 months from stenting (5). It may, therefore, be best to perform noncardiac surgery in patients with coronary stents (regardless of when the stents were implanted) at centers with coronary intervention capability, to allow for prompt treatment if perioperative myocardial infarction and stent thrombosis occur (2). Fully bioabsorbable stents are currently available for clinical use outside the United States and may ultimately obviate the risk of very late stent thrombosis, but this has not yet been suggested in any clinical research study and the early risk of major adverse cardiac events remains. In the interim, we should pay close attention to the technical aspects of coronary stent implantation, as explained subsequently.

Fourth, the risk for perioperative major adverse cardiac events early after stenting was higher among high-risk patients undergoing complex procedures and significantly decreased after 6 months. These patients may be most likely to benefit from delaying any surgery until 6 months after implantation.

Fifth, perioperative major adverse cardiac events occurred more frequently with bare-metal stents than DES. Although this appears paradoxical, it is likely related to patient selection, with sicker patients receiving bare-metal stents. Conversely, bare-metal stent implantation may not be the optimal solution in patients requiring early surgery. Indeed, the cobalt chromium everolimus-eluting stent has a lower overall (not perioperative) risk for stent thrombosis (14). Very late perioperative stent thrombosis can still occur with second-generation DES (13), although the risk may be lower with DES with biodegradable or nonthrombogenic polymers.

Approximately 1 in 5 patients require noncardiac surgery within 2 years post-stenting (15). Attention to meticulous stent implantation technique with the avoidance of edge dissection/trauma, underexpansion, or malapposition; careful consideration of all factors that may lead to unwanted disruption of dual antiplatelet therapy; and utilization of stent types that offer advantages with respect to stent thrombosis are all necessary steps for clinical success. Careful stratification of patients on the basis of clinical and angiographic risks (16) and the inclusion of all medical and surgical colleagues in a careful assessment of the timing of surgery, bleeding risks, and the individualized modes of antiplatelet therapy interruption are also extremely important. The contribution by Holcomb et al. (4) further enhances our ability to provide optimal management and optimal outcomes to these challenging-to-treat patients.

REPRINT REQUESTS AND CORRESPONDENCE: Dr. Emmanouil S. Brilakis, VA North Texas Healthcare System, University of Texas Southwestern Medical Center at Dallas, 4500 South Lancaster Road (111A), Dallas, Texas 75216. E-mail: esbrilakis@gmail.com.

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