Perioperative Complications After Noncardiac Surgery in Patients With Insertion of Second-Generation Drug-Eluting Stents

Nathan Lo, MD[a], Anna Kotsia, MD[b], George Christopoulos, MD[b], Michele Roesle, RN, BSN[b], Bavana V. Rangan, BDS, MPH[b], Bryant J. Kim, MD[c], Alexandra Webb, MD[d], Subhash Banerjee, MD[b], and Emmanouil S. Brilakis, MD, PhD[b,*]

The perioperative outcomes of noncardiac surgery in patients who have received second-generation drug-eluting stents (DESs) have received limited study. We reviewed the medical records of 1,748 consecutive patients who received DES at our institution (1,789 procedures) from January 1, 2009, to July 1, 2012, to determine the outcomes of subsequent noncardiac surgery. During a median follow-up of 43 months, 221 patients underwent 345 noncardiac surgeries (138 low risk, 130 intermediate risk, and 77 high risk), of which 278 were in patients with previous second-generation DES implantation. The incidence of noncardiac surgery in patients with previous second-generation DES implantation was 4.5% at 1 year, 11.6% at 2 years, and 15.2% at 3 years. The mean time from stent implantation to surgery was 21 ± 12.9 months. Mean age was 66 ± 8 years, 99% were men, and 11% had a perioperative complication, including 5.8% major bleeding, 2.5% acute kidney injury, 2.2% major adverse cardiac event, and 1.4% stroke. Perioperative stent thrombosis occurred in 2 patients (0.7%, 95% confidence interval 0.2% to 2.6%): 1 patient had received a DES 14 months before surgery and had stent thrombosis on the day of surgery and the other had a DES implanted 21 months before surgery and developed stent thrombosis the day after surgery. In conclusion, the incidence of perioperative complications with noncardiac surgery after second-generation DES implantation was 11% and consisted mainly of bleeding (5.8%). The incidence of definite stent thrombosis was 0.7%. Published by Elsevier Inc. (Am J Cardiol 2014;114:230−235)

Drug-eluting stents (DESs) significantly reduce the rates of in-stent restenosis compared with bare metal stent implantation.[1] However, concerns emerged for increased risk of stent thrombosis, even many years after DES implantation.[2−5] The perioperative period is a time of increased concern for stent thrombosis, as surgery causes a prothrombotic state and antiplatelet medications are often discontinued.[6−8] Second-generation DESs are made of cobalt-chrome or platinum-chrome platforms and have thinner strut thickness and more biocompatible, durable polymer coatings compared with first-generation DESs. Second-generation DESs further improved the outcomes achieved with first-generation DESs by reducing the risk of restenosis, myocardial infarction (MI), and stent thrombosis.[9,10] The impact of second-generation DESs on the incidence of perioperative stent thrombosis after noncardiac surgery has received limited evaluation[11−13] and formed the focus of the present study.

Methods

We reviewed the records of 1,748 consecutive patients who underwent DES implantation at our institution (1,789 procedures) from January 1, 2009, to July 1, 2012, to determine whether they subsequently underwent noncardiac surgery and whether they developed any perioperative complications.

Stent thrombosis was defined according to the Academic Research Consortium criteria.[14] If patients had multiple stent placements, time to surgery was recorded from the most recent DES placement. First-generation DESs included sirolimus- and paclitaxel-eluting stents (Cypher [Cordis, Warren, New Jersey] and Taxus [Boston Scientific, Natick, Massachusetts]). Second-generation DESs included everolimus-, zotarolimus-, and paclitaxel-eluting platinum chromium stents (Promus [Boston Scientific, Natick, Massachusetts], Xience [Abbott Vascular, Santa Clara, California], Endeavor and Resolute [Medtronic Vascular, Santa Rosa, California], and Ion [Boston Scientific, Natick, Massachusetts]). Patients were considered to have continued preoperative aspirin or ADP P2Y12 inhibitors if the medications were not discontinued or held ≥5 days before surgery. Major adverse cardiac events (MACEs) were defined as perioperative MI, coronary revascularization, and all-cause death. MI was defined as an increase in cardiac biomarkers (creatine kinase, creatine kinase myocardial band, or troponin) ≥3 times upper limit of normal, with at least one of the following: electrocardiographic changes suggestive of ischemia or patient report of chest pain lasting at least 20 minutes. Major bleeding was defined as any bleeding associated with hypotension, estimated blood loss >500 mL, or transfusion of at least 2 units of packed red blood cells. Acute renal failure was defined as a twofold

Departments of [a]Internal Medicine, [b]Cardiovascular Diseases, [c]Anesthesiology, and [d]Surgery, VA North Texas Health Care System and University of Texas Southwestern Medical Center, Dallas, Texas. Manuscript received February 25, 2014; revised manuscript received and accepted April 14, 2014.

See page 234 for disclosure information.

*Corresponding author: Tel: (214) 857-1547; fax: (214) 302-1341
E-mail address: esbrilakis@gmail.com (E.S. Brilakis).

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Table 1
Characteristics of the study patients

Variable	All (221 Patients, 345 Noncardiac Procedures)	Second-Generation DES (180 Patients, 278 Procedures)	First-Generation DES (35 Patients, 58 Procedures)	Both (6 Patients, 9 Procedures)	p
Age (years)	65 ± 8	66 ± 8	65 ± 6	67 ± 7	0.871
Men	219 (99.1%)	178 (98.9%)	35 (100%)	6 (100%)	0.662
Previous myocardial infarction	78 (35%)	65 (36%)	8 (23%)	5 (83%)	0.015
Previous coronary bypass graft surgery	64 (29%)	54 (30%)	8 (23%)	2 (33%)	0.666
Current smoker	66 (33%)	57 (36%)	6 (19%)	3 (50%)	0.107
Ever smoked	164 (82%)	136 (84%)	22 (69%)	6 (100%)	0.042
Average smoking (pack-years)	41 ± 35	43 ± 36	26 ± 25	46 ± 27	0.079
Hyperlipidemia*	197 (89%)	160 (89%)	32 (91%)	5 (83%)	0.820
Hypertension†	197 (89%)	160 (89%)	31 (89%)	6 (100%)	0.496
Diabetes mellitus	122 (55%)	95 (53%)	26 (74%)	1 (17%)	0.008
Diabetes mellitus on insulin	53 (24%)	40 (22%)	13 (37%)	0 (0%)	0.037
Peripheral arterial disease	48 (22%)	42 (23%)	6 (17%)	0 (0%)	0.160
Glomerular filtration rate (ml/min)	75 ± 33	75 ± 31	71 ± 41	90 ± 26	0.253
Chronic renal insufficiency	40 (18%)	32 (18%)	7 (20%)	1 (17%)	0.949
End stage renal disease	14 (6%)	10 (6%)	4 (11%)	0 (0%)	0.328
Left ventricular ejection fraction (%)	51 ± 12	52 ± 12	49 ± 11	52 ± 10	0.418
Number of coronary vessels stented					0.046
1	163 (74%)	138 (77%)	22 (63%)	3 (50%)	
2	49 (22%)	34 (19%)	13 (37%)	2 (33%)	
3	9 (4%)	8 (4%)	0 (0%)	1 (17%)	
Type of coronary stents implanted					<0.001
Paclitaxel	10 (5%)		9 (26%)	1 (17%)	
Sirolimus	28 (13%)		26 (74%)	2 (33%)	
Everolimus	104 (47%)	101 (56%)		3 (50%)	
Zotarolimus	77 (35%)	77 (43%)		0 (0%)	
ION paclitaxel	2 (1%)	2 (1%)		0 (0%)	
Indication for PCI					0.020
Elective	106 (48%)	94 (52%)	11 (31%)	1 (17%)	
Acute coronary syndrome	115 (52%)	86 (48%)	24 (69%)	5 (83%)	
Medications used before surgery					
Aspirin	309 (90%)	249 (90%)	52 (90%)	8 (89%)	1.00
Clopidogrel	200 (58%)	167 (60%)	28 (48%)	5 (56%)	0.255
Prasugrel	11 (3%)	10 (4%)	1 (2%)	0 (0%)	0.546
Ticagrelor	0 (0%)	0 (0%)	0 (0%)	0 (0%)	N/A
Beta-blocker	299 (87%)	244 (88%)	48 (83%)	7 (78%)	0.463
Angiotensin-converting enzyme inhibitor	195 (57%)	161 (58%)	26 (45%)	8 (89%)	0.019
Angiotensin receptor blocker	56 (16%)	44 (16%)	12 (21%)	0 (0%)	0.134
Calcium channel blocker	88 (26%)	79 (28%)	8 (14%)	1 (11%)	0.028
Statin	303 (88%)	240 (86%)	54 (93%)	9 (100%)	0.098
Preoperative aspirin	229 (66%)	188 (68%)	39 (67%)	2 (22%)	0.022
Preoperative thienopyridine	100 (29%)	85 (31%)	13 (22%)	2 (22%)	0.392
Preoperative dual antiplatelet therapy	88 (26%)	76 (27%)	11 (19%)	1 (11%)	0.213
No preoperative antiplatelet therapy	103 (30%)	80 (29%)	17 (29%)	6 (67%)	0.070

Values are mean ± SD or *n* (%).
DES = drug-eluting stent; PCI = percutaneous coronary intervention.
* Hyperlipidemia was defined as low-density cholesterol >100 mg/ml or use of antilipidemic medications.
† Hypertension was defined as blood pressure >140/90 mm Hg or use of antihypertensive medications.

increase in creatinine or decrease by 50% in glomerular filtration rate. Stroke was defined as pathological, imaging, or other objective evidence of cerebral, spinal, or retinal focal ischemic injury in a defined vascular distribution or clinical evidence of cerebral, spinal cord, or retinal focal ischemic injury based on symptoms lasting ≥24 hours or until death, with other etiologies excluded. An event was considered to be postoperative if it occurred within 30 days from noncardiac surgery.

Surgeries were classified as low, intermediate, or high risk according to the American College of Cardiology/American Heart Association guidelines. Low-risk surgeries included endoscopic, superficial, cataract, breast, and ambulatory procedures; intermediate-risk surgeries included intraperitoneal, intrathoracic, carotid endarterectomy, head and neck, and prostate procedures; high-risk surgeries included aortic and other major vascular surgery, peripheral vascular surgery, and emergent surgeries.[15] Simple epidural injections and nerve blocks were excluded from the study.

Continuous parameters were reported as mean ± SD and compared using the Wilcoxon rank-sum test. Discrete parameters were reported as percentages and compared