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Incidence and Outcome of Surgical Procedures After Coronary Bare-Metal and Drug-Eluting Stent Implantation

A Report From the CREDO-Kyoto PCI/CABG Registry Cohort-2

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Background—There still remain safety concerns on surgical procedures after coronary drug-eluting stents (DES) implantation, and optimal management of perioperative antiplatelet therapy (APT) has not been yet established.

Methods and Results—During 3-year follow-up of 12 207 patients (DES=6802 patients and bare-metal stent [BMS] only=5405 patients) who underwent coronary stent implantation in the CREDO-Kyoto registry cohort-2, surgical procedures were performed in 2398 patients (DES=1295 patients and BMS=1103 patients). Surgical procedures (early surgery in particular) were more frequently performed in the BMS group than in the DES group (4.4% versus 1.9% at 42-day and 23% versus 21% at 3-year, log-rank $P=0.0007$). Cumulative incidences of death/myocardial infarction (MI)/stent thrombosis (ST) and bleeding at 30 days after surgery were low, without differences between BMS and DES (3.5% versus 2.9%, $P=0.4$ and 3.2% versus 2.1%, $P=0.2$, respectively). The adjusted risks of DES use relative to BMS use for death/MI/ST and bleeding were not significant (hazard ratio: 1.63, 95% confidence interval: 0.93 to 2.87, $P=0.09$ and hazard ratio: 0.6, 95% confidence interval: 0.34 to 1.06, $P=0.08$, respectively). The risks of perioperative single- and no-APT relative to dual-APT for both death/MI/ST and bleeding were not significant; single-APT as compared with dual-APT tended to be associated with lower risk for death/MI/ST (hazard ratio: 0.4, 95% confidence interval: 0.13 to 1.01, $P=0.053$).

Conclusions—Surgical procedures were commonly performed after coronary stent implantation, and the risk of ischemic and bleeding complications in surgical procedures was low. In patients selected to receive DES or BMS, there were no differences in outcomes. Perioperative administration of dual-APT was not associated with lower risk for ischemic events. **(*Circ Cardiovasc Interv*. 2012;5:237-246.)**

Key Words: stents ■ surgery ■ thrombosis ■ bleeding ■ coronary artery disease

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A report of 3 cases with perioperative stent thrombosis (ST) late (343 to 442 days) after drug-eluting stent (DES) implantation highlighted the increased risk of ST after surgical procedures.[1] Although most previous studies reported a relatively low rate of perioperative ST after surgical procedures in patients with prior DES implantation,[2–6] lingering safety concerns still remain on surgical procedures after DES implantation. Reflecting these safety concerns, a consensus statement from the American College of Cardiology and the American Heart Association recommended bare-metal stent (BMS) implantation or balloon angioplasty with provisional BMS implantation instead of DES implantation in patients undergoing percutaneous coronary intervention (PCI), who would be likely to require invasive or surgical procedures within 12 months, and recommended postponing elective surgery for at least 1 year in patients in whom a DES had been implanted[7]; however, considering the scarcity of data supporting these recommendations, several issues need to be addressed regarding management of patients undergoing surgical procedures after coronary stent implantation. Safety of surgical procedures after DES implantation relative to those after BMS implantation has not been yet adequately evaluated. Furthermore, optimal management of perioperative antiplatelet therapy (APT), balancing ischemic and bleeding risk, has not been yet established. Therefore, we sought to investigate the incidence and predictors of the surgical procedures after coronary stent implantation and to evaluate ischemic and bleeding outcome after the surgical procedures, focusing on the impact of types of implanted stents (DES versus BMS), and status of perioperative APT (dual-, single-, and no-APT) in a large observational database in Japan.

WHAT IS KNOWN

- Surgical procedures after coronary drug-eluting stent implantation, early surgery in particular, carry significant risk for perioperative stent-related ischemic as well as bleeding complications.

WHAT THE STUDY ADDS

- Surgical procedures were commonly performed after coronary stent implantation in the real clinical practice in Japan (22% at 3 years).
- Incidences of ischemic and bleeding complications after surgical procedures were acceptably low, with no differences regardless of bare-metal stents and drug-eluting stents use.
- Perioperative administration of dual-antiplatelet therapy was not associated with lower risk for ischemic events.

Methods

Study Population

The Coronary REvascularization Demonstrating Outcome study in Kyoto (CREDO-Kyoto) PCI/coronary artery bypass grafting (CABG) registry cohort-2 is a physician-initiated non-company–sponsored multicenter registry, enrolling consecutive patients undergoing first coronary revascularization, among 26 centers in Japan, between January 2005 and December 2007. The relevant review boards or ethics committees in all 26 participating centers (online-only Supplemental Appendix A) approved the research protocol. Because of retrospective enrollment, written informed consents from the patients were waived; however, we excluded those patients who refused participation in the study when contacted for follow-up.

The study design and patient enrollment of the CREDO-Kyoto PCI/CABG registry cohort-2 were previously described in detail.[8] During the 3 years of enrollment period, 13 144 patients underwent PCI as the first coronary revascularization procedure. Excluding 57 patients (0.4%) who refused study participation and 880 patients (6.7%) without stent implantation, the study population for the current prespecified substudy of the CREDO-Kyoto PCI/CABG registry cohort-2 consisted of 12 207 patients who underwent coronary stent implantation. At least one DES was used in 6802 patients, while BMS was exclusively used in 5405 patients. During follow-up, non-CABG surgical procedures were performed in 2398 patients (DES: 1295 patients and BMS: 1103 patients), who constituted the study population for evaluating clinical outcome after surgery (Figure 1).

Definitions

Surgical procedures during follow-up, excluding CABG, were captured as follow-up events after PCI. Surgical procedures were defined as the procedures performed under general, spinal, or local anesthesia. Percutaneous endovascular procedures were not regarded as surgical procedures, although gastrointestinal endoscopic therapeutic procedures were included in the surgical procedures. We excluded those surgical procedures related to the index PCI, such as vascular repair, and those related to mechanical complications of acute myocardial infarction at presentation. The type of anesthesia (general/spinal versus local anesthesia) was regarded as a surrogate for major versus minor surgery. The timing of the surgical procedures after stent implantation was categorized into the 2 prespecified subgroups (early surgery: within 42 days and late surgery: beyond 42 days after stent implantation), based on the previous reports suggesting increased risk for adverse events in patients undergoing surgical procedures within 6 to 8 weeks after BMS[9–12] and DES[2,5,13] implantation.

The recommended APT regimen was aspirin (≥81 mg daily) indefinitely and thienopyridine (200 mg ticlopidine or 75 mg clopidogrel daily) for at least 1 month after BMS implantation and for at least 3 months after DES implantation. The duration of dual-APT and management of perioperative APT was left to the discretion of each attending physician. Data on the status of APT was collected throughout the follow-up period. Persistent discontinuation was defined as withdrawal lasting at least 2 months. Status of perioperative APT was classified into the 3 groups (dual-, single-, and no-APT), according to the status on the day before the surgical procedures.

Clinical and procedural characteristics and medications were not evaluated at the time of the surgical procedures but were evaluated at the time of the index PCI procedures.

End Points

All the end points evaluated in this study were predefined. The primary outcome measures for ischemic and bleeding events were a composite of death, myocardial infarction (MI), or ST (definite/probable) and moderate or severe bleeding by Global Utilization of Streptokinase and Tissue plasminogen activator for Occluded coronary arteries (GUSTO) classification,[14] respectively, which were assessed at 30 days after the surgical procedures. Individual components of the primary ischemic outcome measure were also evaluated. Definitions of other cardiovascular end points were previously reported.[8]

Data Collection and Follow-Up

Demographic, angiographic, and procedural data were collected from hospital charts or hospital databases, according to prespecified

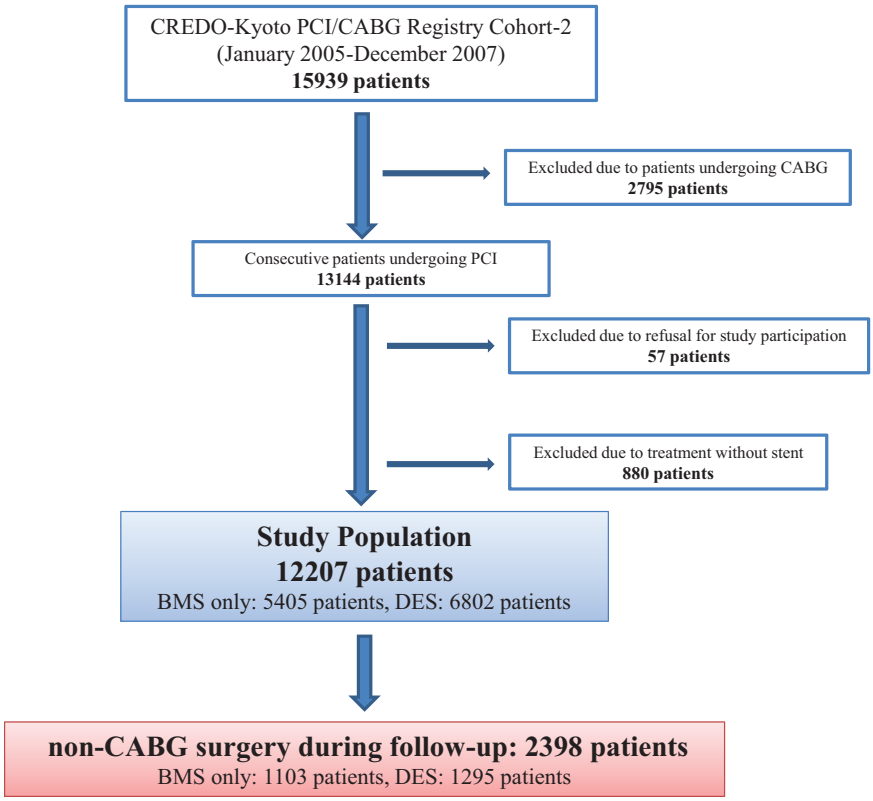


Figure 1. Study flow chart. BMS indicates bare-metal stents; CABG indicates coronary artery bypass grafting; CREDO-Kyoto, Coronary REvascularization Demonstrating Outcome study in Kyoto; DES, drug-eluting stents; PCI, percutaneous coronary intervention.

definitions by experienced clinical research coordinators who belonged to the independent research organization (Research Institute for Production Development, Kyoto, Japan) (online-only Supplemental Appendix B). Baseline data forms were double-checked by a second clinical research coordinator in 1727 patients (13%). Follow-up data were obtained from hospital charts or by contacting patients or referring physicians. Clinical events such as death, MI, ST, and bleeding were adjudicated by the clinical event committee (online-only Supplemental Appendix C).

Median follow-up duration for surviving patients was 942 (interquartile range [IQR]: 676 to 1229) days. Complete 1-year follow-up information after the index stent implantation procedure was obtained in 11 770 patients (96.4%) out of 12 207 study patients. Complete 30-day follow-up information after the surgical procedure was available in 2302 patients (96.0%) out of 2398 eligible patients.

Statistical Analysis

Data are presented as values and percentages or mean value±standard deviation or median and IQR. Categorical variables were compared with the χ^2 test or the Fisher exact test. Continuous variables were compared using the Student t test or Wilcoxon rank sum test, based on their distributions. Cumulative incidences of the surgical procedures after the index stent implantation and the clinical events after the surgical procedures were estimated by the Kaplan-Meier method, and differences were assessed with the log-rank test.

Clinical and procedural characteristics and baseline medications were compared between the 2 groups of patients with or without surgical procedures during follow-up (online only Supplemental Table I). Multivariable logistic regression analysis was conducted to identify independent predictors for the occurrence of surgical procedures within 1 year after the index stent implantation. Those patients who did not complete 1-year follow-up without surgical procedures were excluded from the multivariable logistic regression analysis. Baseline characteristics of 901 patients excluded in the multivariable regression analysis were markedly different from those included in the analysis. Variables indicated in Table 1 were used as potential independent predictors. The continuous variables were dichotomized by clinically meaningful reference values or median values.

The effects of the types of implanted stents (DES versus BMS) and status of perioperative APT (dual-, single-, and no-APT) for the primary outcome measures were evaluated by multivariable Cox proportional hazard models. Patients with missing values were excluded from the multivariable analyses. Baseline characteristics of 256 patients excluded in the multivariable Cox proportional hazard regression analyses were not different from those included in the analysis. Potential independent risk-adjusting variables in the Cox models were indicated in Table 1. Independent correlates for the primary outcome measures were identified by a backward elimination procedure. The final model incorporated the types of stents and status of perioperative APT, as well as types of anesthesia (general/spinal versus local anesthesia) and timing of surgery (within 42 days versus beyond 42 days after stent implantation), together with those variables remaining after the backward procedure. Regarding status of perioperative APT, the effects of single-APT and no-APT relative to dual-APT were evaluated by using dummy variables. The effects of the types of stents and status of perioperative APT were expressed as hazard ratios (HR) and their 95% confidence intervals (CI).

All analyses were conducted by 2 physicians (Drs Tokushige and Shiomi) and a statistician (Morimoto) with the use of JMP 8.0 (SAS Institute Inc). All the statistical analyses were 2-tailed, and probability values <0.05 were considered statistically significant.

Results

Incidence and Predictors of Surgical Procedures

Patients with high-risk features such as old age, diabetes, renal failure, and acute myocardial infarction were commonly enrolled in the registry (Table 1, and online-only Supplemental Table I). During the 3-year follow-up after stent implantation, surgical procedures were performed commonly (22% at 3 years) (Figure 2A). Incidence of surgical procedures (early surgery, in particular) was significantly higher after BMS implantation than after DES implantation (4.4% versus

Table 1. Baseline Characteristics of Patients With Surgery After Coronary Stent Implantation: BMS Versus DES

Variables	All Patients With Surgery N=2398	BMS N=1103	DES N=1295	*P* Value
Clinical characteristics				
Age (y)	70.0±9.6	70.2±9.8	69.8±9.3	0.3
Age >=75 y*	839 (35%)	401 (36%)	438 (34%)	0.2
Male*	1767 (74%)	840 (74%)	949 (72%)	0.3
BMI	23.5 (21.3–25.6)	23.3 (20.9–25.5)	23.6 (21.5–25.8)	0.01
BMI <25.0*	1705 (70%)	792 (72%)	878 (68%)	0.03
Acute coronary syndrome	914 (38%)	583 (53%)	331 (26%)	<0.0001
Acute myocardial infarction*	739 (31%)	497 (45%)	242 (19%)	<0.0001
Hypertension*	2002 (84%)	893 (81%)	1109 (86%)	0.002
Diabetes mellitus	1006 (42%)	400 (36%)	606 (47%)	<0.0001
On insulin therapy*	263 (11%)	77 (7.0%)	186 (14%)	<0.0001
Current smoking*	715 (30%)	375 (33%)	350 (27%)	0.0003
Heart failure*	580 (24%)	270 (25%)	310 (24%)	0.8
Shock at presentation*	155 (6.5%)	110 (10%)	45 (3.5%)	<0.0001
Multivessel disease*	1413 (59%)	553 (50%)	860 (66%)	<0.0001
Mitral regurgitation grade 3/4*	115 (4.8%)	55 (8.1%)	60 (6.1%)	0.1
Ejection fraction	57.9±13.7	57.5±13.3	58.2±14	0.3
Prior myocardial infarction*	293 (12%)	103 (9.3%)	190 (15%)	<0.0001
Prior stroke*	308 (13%)	125 (11%)	183 (14%)	0.04
Peripheral vascular disease*	348 (15%)	190 (17%)	158 (12%)	0.0005
eGFR <30, not on dialysis*	166 (6.9%)	77 (7.0%)	89 (6.9%)	0.9
Dialysis*	139 (5.8%)	43 (3.9%)	96 (7.4%)	0.0002
Atrial fibrillation*	247 (10%)	116 (11%)	131 (10%)	0.7
Anemia (Hb <11.0 g/dl)*	404 (17%)	175 (16%)	229 (18%)	0.2
Platelet $<100*10^9$/L*	38 (1.6%)	14 (1.3%)	24 (1.9%)	0.3
COPD*	116 (4.8%)	56 (5.1%)	60 (4.6%)	0.6
Liver cirrhosis*	90 (3.8%)	45 (4.1%)	45 (3.5%)	0.4
Malignancy*	348 (15%)	194 (18%)	154 (12%)	<0.0001
Lesion and procedural characteristics				
DES use*	1295 (54%)	0 (0%)	1295 (100%)	<0.0001
Types of DES				
Sirolimus-eluting stent		0 (0%)	1205 (93%)	
Paclitaxel-eluting stent		0 (0%)	56 (4.3%)	
No. of target lesions	1 (1–2)	1 (1–2)	1 (1–2)	<0.0001
	1.5±0.77	1.34±0.65	1.63±0.84	
Target of proximal LAD*	1384 (58%)	577 (52%)	807 (62%)	<0.0001
Target of unprotected LMCA*	104 (4.3%)	36 (3.3%)	68 (5.3%)	0.02
Target of CTO*	243 (10%)	62 (5.6%)	181 (14%)	<0.0001
Target of bifurcation*	770 (32%)	246 (22%)	524 (41%)	<0.0001
Side-branch stenting*	119 (5.0%)	34 (3.1%)	85 (6.6%)	<0.0001
Total No. of stents	1 (1–2)	1 (1–2)	2 (2–3)	<0.0001
	1.88±1.24	1.53±0.91	2.18±1.39	
Total stent length (mm)	28 (18–51)	24 (18–38)	38 (23–64)	<0.0001
	39.9±29.1	30.4±20.4	47.9±32.8	
Total stent length >28 mm*	1194 (50%)	407 (37%)	787 (61%)	<0.0001
Minimum stent size (mm)	3 (2.5–3)	3 (2.5–3.5)	2.5 (2.5–3)	<0.0001
	2.91±0.45	3.06±0.48	2.79±0.37	
Minimum stent size <3.0 mm*	1052 (44%)	336 (30%)	716 (55%)	<0.0001

(*Continued*)

Table 1. Continued

Variables	All Patients With Surgery N=2398	BMS N=1103	DES N=1295	*P* Value
Baseline medications				
Antiplatelet therapy				
Thienopyridine	2366 (99%)	1077 (98%)	1289 (100%)	<0.0001
Ticlopidine	2199 (93%)	1009 (94%)	1190 (92%)	0.9
Clopidogrel	163 (6.9%)	65 (6.1%)	98 (7.6%)	
Aspirin	2365 (99%)	1086 (98%)	1279 (99%)	0.5
Cilostazol†	452 (19%)	220 (20%)	232 (18%)	0.2
Other medications				
Statins†	1116 (47%)	467 (42%)	649 (50%)	<0.0001
Beta-blockers†	720 (30%)	352 (32%)	368 (28%)	0.06
ACE-I/ARB†	1356 (57%)	617 (56%)	739 (57%)	0.6
Nitrates†	852 (36%)	363 (33%)	489 (38%)	0.01
Calcium channel blockers†	1008 (42%)	418 (38%)	590 (46%)	<0.0001
Nicorandil†	583 (24%)	302 (27%)	281 (22%)	0.001
Warfarin†	224 (9.3%)	97 (8.8%)	127 (9.8%)	0.4
Proton pump inhibitors†	665 (28%)	336 (31%)	329 (25%)	0.006
H2-blockers†	568 (24%)	277 (25%)	291 (23%)	0.1
Factors related to surgery				
Surgery within 42 d	355 (15%)	227 (21%)	128 (9.9%)	<0.0001
General/spinal anesthesia	1056 (45%)	550 (51%)	506 (40%)	<0.0001
Dual-APT	581 (27%)	167 (17%)	414 (35%)	<0.0001
No-APT	1160 (53%)	614 (62%)	546 (46%)	<0.0001
Single-APT	444 (20%)	211 (21%)	233 (20%)	0.3

Continuous variables are shown as mean±SD or median (interquartile range).

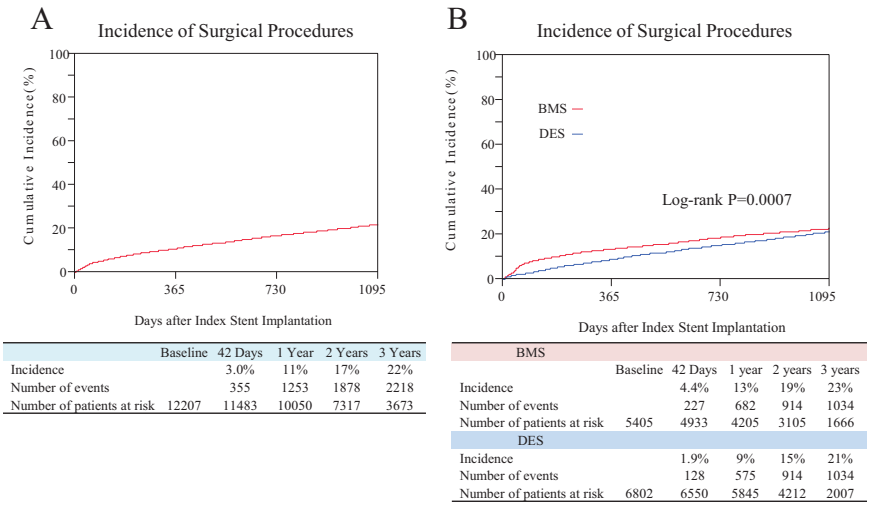
There were missing values for BMI in 73 patients, for ejection fraction in 409 patients, for total stent length in 1 patient, for minimum stent size in 1 patient, for types of anesthesia in 49 patients, and for preoperative status of APT in 213 patients.

ACE-I indicates angiotensin converting enzyme inhibitor; APT, antiplatelet therapy; ARB, angiotensin receptor blocker; BMI, body mass index; BMS, bare-metal stents; COPD, chronic obstructive pulmonary disease; CTO, chronic total occlusion; DES, drug-eluting stents; eGFR, estimated glomerular filtration rate; Hb, hemoglobin; H2-blocker, histamine type 2 receptor blocker; LAD, left anterior descending coronary artery; LMCA, left main coronary artery; PPI, proton pump inhibitor.

*Potential independent variables selected for the logistic regression model and the Cox proportional hazard models, and †potential independent variables selected for the Cox proportional hazard models only.

1.9% at 42 days and 23% versus 21% at 3 years, log-rank $P=0.0007$) (Figure 2B). Common surgical fields included vascular surgery, abdominal surgery, ophthalmic surgery, and gastrointestinal endoscopic procedures (Table 2).

As compared with patients without surgical procedures during follow-up, patients with surgical procedures were older and had more comorbidities (online-only Supplemental Table I). Independent predictors for the occurrence of surgi-



	Baseline	42 Days	1 Year	2 Years	3 Years
Incidence		3.0%	11%	17%	22%
Number of events		355	1253	1878	2218
Number of patients at risk	12207	11483	10050	7317	3673

	Baseline	42 Days	1 year	2 years	3 years
BMS					
Incidence		4.4%	13%	19%	23%
Number of events		227	682	914	1034
Number of patients at risk	5405	4933	4205	3105	1666
DES					
Incidence		1.9%	9%	15%	21%
Number of events		128	575	914	1034
Number of patients at risk	6802	6550	5845	4212	2007

Figure 2. Cumulative incidence of surgical procedures through 3 years after index stent implantation: (**A**) entire cohort; and (**B**) comparison between BMS and DES. BMS indicates bare-metal stents; DES, drug-eluting stents.

Table 2. Fields of Surgical Procedures

Surgical Fields	No. of Patients (%)	BMS	DES
All	2398	1103	1295
Vascular surgery	370 (15%)	207 (19%)	163 (13%)
Abdominal surgery	352 (15%)	157 (14%)	195 (15%)
Ophthalmic surgery	291 (12%)	91 (8.3%)	200 (15%)
Gastrointestinal endoscopic procedures	276 (12%)	118 (11%)	158 (12%)
Oral and maxillofacial surgery	214 (8.9%)	81 (7.3%)	133 (10%)
Orthopedic surgery	212 (8.8%)	85 (7.7%)	127 (9.8%)
Pacemaker implantation	152 (6.3%)	75 (6.8%)	77 (5.9%)
Urologic surgery	115 (4.8%)	55 (5.0%)	60 (4.6%)
Respiratory surgery	110 (4.6%)	69 (6.3%)	41 (3.2%)
Cardiac surgery	84 (3.5%)	52 (4.7%)	32 (2.5%)
Neurosurgery	56 (2.3%)	24 (2.2%)	32 (2.5%)
Dermatologic surgery	53 (2.2%)	23 (2.1%)	30 (2.3%)
Otorhinolaryngological surgery	51 (2.1%)	31 (2.8%)	20 (1.5%)
Mammary surgery	21 (0.9%)	13 (1.2%)	8 (0.6%)
Gynecological surgery	17 (0.7%)	8 (0.7%)	9 (0.7%)
Others	19 (0.8%)	11 (1.0%)	8 (0.6%)
Unknown	5 (0.2%)	3 (0.3%)	2 (0.2%)

BMS indicates bare-metal stents; DES, drug-eluting stents.

cal procedures within the first year after coronary stent implantation, identified by multivariable logistic regression analysis, were advanced age, male gender, multivessel disease, shock at presentation, heart failure, atrial fibrillation, liver cirrhosis, malignancy, renal failure, insulin-treated diabetes, and anemia, although negative predictors were DES-use and acute myocardial infarction presentation (online-only Supplemental Table II).

Clinical Outcome After Surgical Procedures

Cumulative incidences of the primary outcome measures for ischemic and bleeding events at 30 days after surgical procedures were low (death/MI/ST: 3.2% and GUSTO moderate/severe bleeding: 2.6%, respectively) (Table 3). Death was the dominant component of the primary ischemic outcome measure; however, the proportion of death related to postoperative ischemic complications was relatively small (Table 4). Incidences of MI and definite or probable ST at 30 days after surgical procedures were low (0.6% and 0.4%, respectively). Detailed information on 7 patients with angiographically documented ST was presented in online-only Supplemental Table III.

Minor surgery as compared with major surgery was associated with significantly lower risk for both ischemic and bleeding complications ($P=0.001$ and $P=0.04$, respectively) (online-only Supplemental Tables IV and V). Incidences of death/MI/ST and bleeding at 30 days after surgical procedures were both significantly higher in patients with early surgery than in patients with late surgery (Figure 3, and online-only Supplemental Tables IV and V). After 42 days, incidences of death/MI/ST at 30 days after surgical procedures remained relatively constant throughout the first year and beyond 1 year (Figure 4).

Table 3. Adverse Event Rates at 30 Days After Surgical Procedures

End Points	All N of Events (Incidence)	BMS N of Events (Incidence)	DES N of Events (Incidence)	*P* Value
Death/MI/ST (definite or probable)	75 (3.2%)	38 (3.5%)	37 (2.9%)	0.4
Death				
All-cause death	65 (2.8%)	33 (3.0%)	32 (2.5%)	0.4
Cardiac death	41 (1.7%)	24 (2.2%)	17 (1.3%)	0.1
Noncardiac death	24 (1.0%)	9 (0.8%)	15 (1.2%)	0.3
Sudden death	5 (0.2%)	2 (0.2%)	3 (0.2%)	0.3
MI	13 (0.6%)	6 (0.6%)	7 (0.6%)	1.0
Stroke	28 (1.2%)	14 (1.3%)	14 (1.1%)	0.8
Stent thrombosis				
Definite	7 (0.3%)	2 (0.2%)	5 (0.4%)	0.4
Definite or probable	9 (0.4%)	3 (0.3%)	6 (0.5%)	0.4
Hospitalization for heart failure	20 (0.9%)	10 (0.9%)	10 (0.8%)	0.5
Bleeding	60 (2.6%)	33 (3.2%)	27 (2.1%)	0.2
Any coronary revascularization	85 (3.6%)	48 (4.4%)	37 (2.9%)	0.3

Cumulative incidences of events were estimated by the Kaplan-Meier method.
BMS indicates bare-metal stents; DES, drug-eluting stents; MI, myocardial infarction; ST, stent thrombosis.

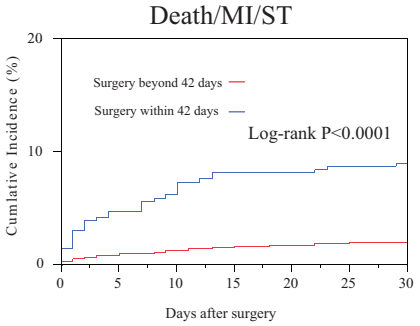
Types of Implanted Stents and Clinical Outcome: BMS versus DES

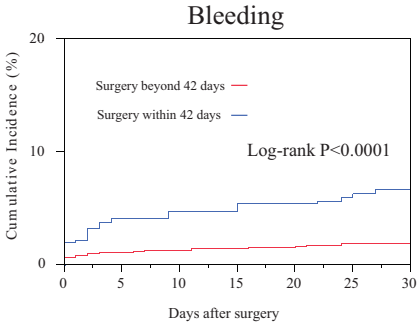
Cumulative incidences of death/MI/ST and bleeding at 30 days after surgical procedures were not different between the BMS and DES groups (Figure 5). The BMS group included

Table 4. Causes of Death Within 30 Days After Surgical Procedures

Causes of Death	No. of Patients (Proportion) All (N=65)	BMS (N=33)	DES (N=32)
Cardiac death	41 (63%)	24 (73%)	17 (53%)
MI related to post-operative ST (definite/probable)	2 (3.1%)	1 (3.0%)	1 (3.1%)
Sudden death	6 (9.2%)	3 (9.1%)	3 (9.3%)
Heart failure, no evidence of MI	5 (7.7%)	2 (6.1%)	3 (9.4%)
Complications of preoperative MI	21 (32%)	16 (48%)	5 (16%)
Others	7 (11%)	2 (6.1%)	5 (16%)
Noncardiac death	24 (37%)	9 (27%)	15 (47%)
Infection	4 (6.2%)	2 (6.1%)	2 (6.3%)
Renal failure	2 (3.1%)	1 (3.0%)	1 (3.1%)
Stroke	5 (7.7%)	2 (6.1%)	3 (9.4%)
Bleeding	1 (1.5%)	0 (0.0%)	1 (3.1%)
Others	12 (18%)	4 (12%)	8 (25%)

BMS indicates bare-metal stents; DES, drug-eluting stents; MI, myocardial infarction; ST, stent thrombosis.





Surgery beyond 42 days			
	Baseline	7 Days	30 Days
Incidence		1.0%	2.0%
Number of events		21	41
Number of patients at risk	2043	2000	1909
Surgery within 42 days			
Incidence		5.6%	9.6%
Number of events		20	34
Number of patients at risk	355	336	320

Surgery beyond 42 days			
	Baseline	7 Days	30 Days
Incidence		1.3%	1.9%
Number of events		26	38
Number of patients at risk	2043	1932	1835
Surgery within 42 days			
Incidence		4.1%	6.7%
Number of events		14	22
Number of patients at risk	355	308	287

Figure 3. Cumulative incidence of death/MI/ST and bleeding within 30 days after surgical procedures; early versus late surgical procedures. MI indicates myocardial infarction; ST, stent thrombosis.

more patients with acute myocardial infarction presentation, heart failure, peripheral vascular disease, malignancy, general/spinal anesthesia, and early surgery, while the DES group included more patients with diabetes, prior MI, dialysis, anatomically complex disease, and perioperative dual-APT (Table 1). After adjusting confounders, the risk of DES-use relative to BMS-use for ischemic and bleeding events remained insignificant (HR1.63, 95% CI: 0.93 to 2.87, $P=0.09$, and HR: 0.6, 95% CI: 0.34 to 1.06, $P=0.08$, respectively) (online-only Supplemental Tables IV and V). The higher risk for both ischemic and bleeding complications in patients with surgery within 42 days was consistently seen in both BMS and DES strata (online only Supplemental Figure I). Incidence of definite or probable ST was not different between the BMS and DES groups (Table 3). Regarding the causes of death, the proportion of death related to postoperative ischemic complications was also similar between the BMS and DES groups (Table 4).

Status of Perioperative APT and Clinical Outcome

Cumulative incidence of persistent discontinuation of thienopyridine was significantly higher in patients treated with BMS than in patients with DES ($P<0.0001$) (online-only Supplemental Figure II). At 1 year after the index stent implantation procedure, 23% of patients in the BMS group and 66% of patients in the DES group continued dual antiplatelet therapy. Status of perioperative APT included dual-APT in 581 patients (27%), single-APT in 444 patients (aspirin alone: 429 patients and thienopyridine alone: 15 patients) (20%), no-APT in 1160 patients (53%), and unknown in 213 patients (8.9%). Discontinuation of aspirin within 30 days of the surgical procedures was reported in 1069 patients, with median duration of discontinuation for 7 (IQR 5 to 8) days before surgery. Aspirin was reported to be resumed in 1016 patients, with median interval of 3 (IQR 1 to 8) days after surgery. Discontinuation of thienopyridines within 30 days of the surgical procedures was reported in 838

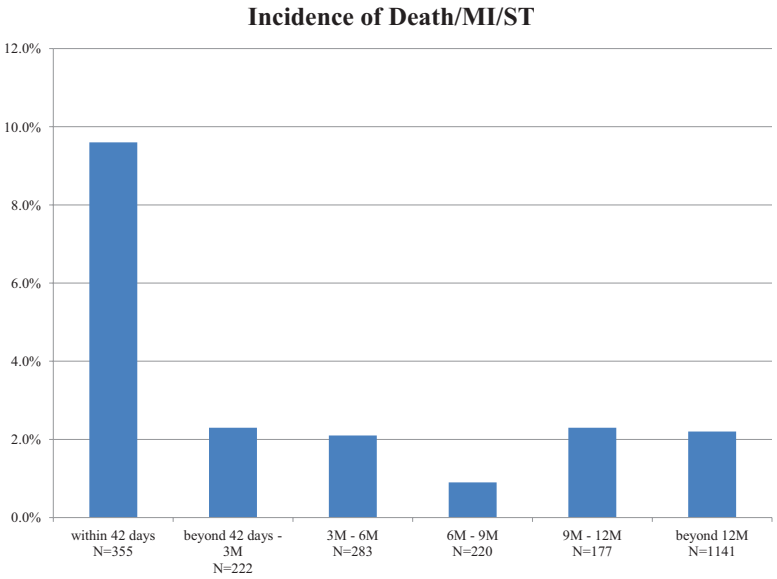
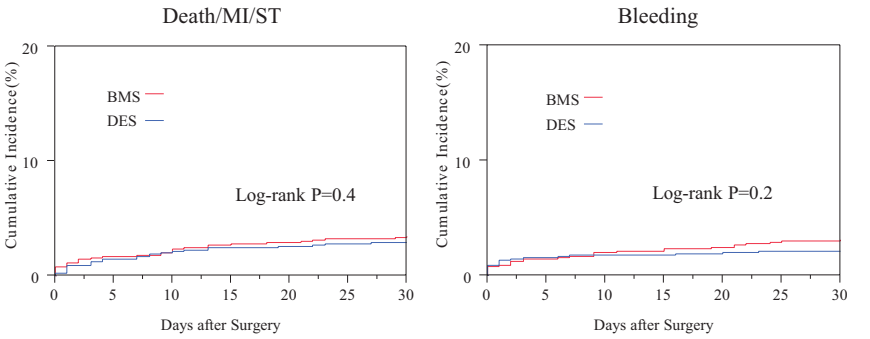


Figure 4. Incidences of death/MI/ST within 30 days after surgical procedures, according to various timing of surgery after the index PCI procedure. M indicates months; MI, myocardial infarction; ST, stent thrombosis.



BMS	Baseline	7 Days	30 Days
Incidence		1.7%	3.5%
Number of events		19	38
Number of patients at risk	1103	1075	1027
DES			
Incidence		1.7%	2.9%
Number of events		22	37
Number of patients at risk	1295	1261	1202

BMS	Baseline	7 Days	30 Days
Incidence		1.7%	3.2%
Number of events		18	33
Number of patients at risk	1103	1025	967
DES			
Incidence		1.7%	2.1%
Number of events		22	27
Number of patients at risk	1295	1215	1155

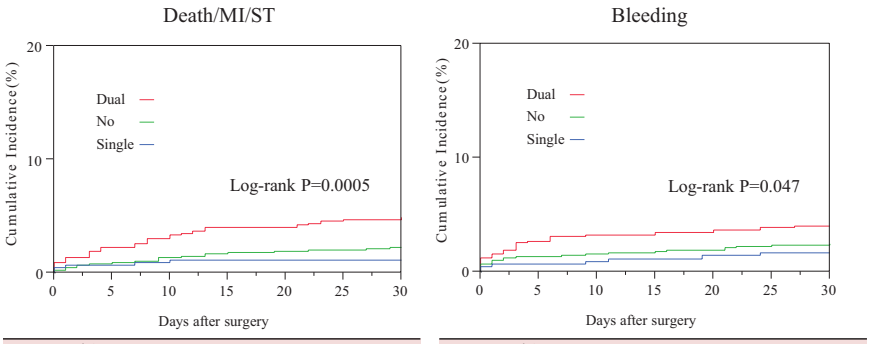
Figure 5. Cumulative incidence of death/MI/ST and bleeding within 30 days after surgical procedures: BMS versus DES. BMS indicates bare-metal stents; DES, drug-eluting stents; MI, myocardial infarction; ST, stent thrombosis.

patients, with median duration of discontinuation for 7 (IQR 6 to 12) days before surgery. Thienopyridines were reported to be resumed in 613 patients, with median interval of 4 (IQR 1 to 10) days.

Cumulative incidences of death/MI/ST and bleeding at 30 days after surgical procedures were both significantly higher in patients with dual-APT than in patients with single- or no-APT (Figure 6). Perioperative dual-APT was associated with a statistically insignificant trend for higher incidence of death/MI/ST in patients who underwent surgical procedures in the interval between 31 days and 1 year after an index PCI procedure (online-only Supplemental Figure III). Patients in the dual-APT group had more comorbidities than patients in the single- or no-APT groups (online-only Supplemental Table VI). After adjusting confounders, perioperative single-APT relative to dual-APT tended to be associated with lower risk for ischemic events and with similar risk for bleeding events (HR: 0.4, 95% CI: 0.13 to1.01, P=0.053 and HR: 0.59, 95% CI: 0.22 to 1.42, P=0.2, respectively), but the difference did not reach statistical significance. The risks of no-APT relative to dual-APT for both ischemic and bleeding events were not significant (HR: 0.64, 95% CI: 0.33 to 1.23, P=0.2 and HR: 0.64, 95% CI: 0.33 to 1.27, P=0.2, respectively) (online-only Supplemental Tables IV and V). The trend for higher risk for ischemic complications in the dual-APT group relative to single-APT group was consistently seen in both BMS and DES strata (P=0.01 and P=0.03, respectively) (online-only Supplemental Figure IV). Incidence of definite or probable ST was not different across the 3 groups (single-APT: 0.2%, dual-APT: 0.5%, and no-APT: 0.4%, P=0.8) (online-only Supplemental Table VII).

Discussion

The main findings of this study are as follows: (1) surgical procedures were commonly performed after coronary stent implantation; (2) incidences of ischemic and bleeding com-



Dual APT	Baseline	7 Days	30 Days
Incidence		2.6%	4.9%
Number of events		15	28
Number of patients at risk	581	559	534
No APT			
Incidence		1.0%	2.3%
Number of events		11	26
Number of patients at risk	1160	1140	1088
Single APT			
Incidence		0.9%	1.1%
Number of events		4	5
Number of patients at risk	444	436	416

Dual APT	Baseline	7 Days	30 Days
Incidence		3.1%	4.0%
Number of events		17	22
Number of patients at risk	581	515	490
No APT			
Incidence		1.5%	2.4%
Number of events		17	27
Number of patients at risk	1160	1104	1044
Single APT			
Incidence		0.7%	1.6%
Number of events		3	7
Number of patients at risk	444	426	403

Figure 6. Cumulative incidence of death/MI/ST and bleeding within 30 days after surgical procedures, according to the status of perioperative APT. APT indicates antiplatelet therapy; MI, myocardial infarction; ST, stent thrombosis.

plications after surgical procedures were acceptably low, with no differences, regardless of BMS and DES use; (3) perioperative administration of dual-APT was not associated with lower risk for ischemic events.

Concordant with the recommendation by a consensus statement from the American College of Cardiology and the American Heart Association,[7] BMS instead of DES are predominantly used in the real clinical practice in patients who would be likely to require invasive or surgical procedures, which was clearly demonstrated by the higher incidence of early surgical procedure in the BMS group in the current analysis; however, in consistent with previous studies reporting 4% to 7% annual incidence of surgical procedures after stent implantation,[5,6,15] the present study demonstrated that the need for surgical procedures often develop *after* a coronary stent has been implanted. Therefore, it is our contention that the recommendation to avoid the use of DES could hardly address the whole issues concerning surgical procedures after DES implantation. Furthermore, although surgical procedures after DES implantation, as compared with those after BMS implantation, are generally regarded as carrying higher risk for perioperative ischemic and bleeding complications, this notion has not been proven in clinical studies. Recently, a retrospective cohort study from Scotland analyzed 1953 patients with noncardiac surgical procedures after coronary stent implantation and found no differences between DES and BMS in the primary end point of in-hospital mortality or ischemic cardiac events.[13] The current study, evaluating the largest-ever number of patients with surgical procedures after coronary stent implantation, consistently demonstrated that the incidence of the primary ischemic outcome measure at 30 days after surgery was not different between the BMS and DES groups. Acceptably low ischemic event rate in the DES group shown in the current study was consistent with our previous report,[5] although a rate of ST of 0.4% within 30 days appeared to be higher than the annual incidences of late and very late ST of 0.2 to 0.6% (0.02 to 0.05%/mo) reported previously. Furthermore, despite higher prevalence of perioperative dual-APT in patients receiving DES, 30-day bleeding outcome was also not different between the BMS and DES groups. According to these observations, choice of DES might be a reasonable option, even in patients who are likely to undergo surgical procedures, if risk of restenosis is expected to be very high.

Consistent with previous reports,[2,5,9–13] surgical procedures performed early after coronary stent implantation were associated with significantly higher risk for both ischemic and bleeding complications than those performed late after coronary stent implantation. Therefore, it would be reasonable to postpone, whenever possible, surgical procedures at least a few months after coronary stent implantation. A consensus statement from the American College of Cardiology and the American Heart Association recommended postponing elective surgery for at least 1 year in patients in whom a DES has been implanted.[7] Although the optimal duration of the delay is not yet known, duration shorter than 1 year might be appropriate, considering the very low incidence of ischemic and bleeding events with surgical procedures beyond 42 days in the current study.

In the current analysis, perioperative administration of dual-APT as compared with single- or no-APT was not associated with lower risk for ischemic events. Although it seems to be paradoxical that the dual-APT as compared with single-APT tended to be associated with higher risk for ischemic events, bleeding could be a trigger for ischemic events. Perioperative administration of thienopyridines was reported to be associated with higher risk for bleeding, although discontinuation of both aspirin and thienopyridine was reported to be associated with higher risk for ST even beyond 1 year after DES implantation.[16] Therefore, it would be recommended to continue aspirin in most patients undergoing surgical procedures after coronary stent implantation except for those surgical procedures, such as intracranial surgery and spinal surgery, where serious clinical consequences are expected after bleeding.

Study Limitations

There are several important limitations in this study. First, we did not collect data on the clinical status at the time of surgical procedures and urgency of the procedures, which would be a critical determinant of clinical outcome after surgical procedures. Second, collection of follow-up data was conducted mainly based on hospital charts of the cardiology divisions. Underestimation of the incidence of surgical procedures is possible because the attending cardiologists might not have recognized all the surgical procedures conducted. Third, use of the GUSTO definition might be inappropriate for evaluating perioperative bleeding events. Fourth, ticlopidine instead of clopidogrel was used as the thienopyridine in most patients. Also, the dose of 200 mg of ticlopidine was much lower than the doses used outside Japan. Fifth, the baseline characteristics were markedly different between BMS and DES. Despite extensive statistical adjustment, the influence of unmeasured confounders and interactions of stent types with various clinical factors, including timing of surgery, and antiplatelet therapy made it very difficult to make comparison between BMS and DES. Furthermore, the comparisons between BMS and DES for ischemic and bleeding outcomes were obviously underpowered because of the small number of events, making it difficult to draw definitive conclusions. Finally, information on perioperative antiplatelet therapy might not be accurate because we did not systematically review the surgical hospital charts at the time of the surgical procedures. The surgeons might have had discontinued APT without notice to the attending cardiologists. Also, information regarding discontinuation of APT, obtained by contact with patients, was based on retrospective recall by the patients or relatives, suggesting a potential for recall bias. Furthermore, the risk of adverse cardiac events after surgical procedures are influenced by several factors other than the perioperative status of APT, including morbidities of patients, invasiveness of surgical procedures, timing of surgery after stent implantation, and different lengths of time of discontinuation of APT. In real clinical practice, perioperative management of APT would have had been modified according to the risk profile that a given patient had. This makes it very difficult to compare the risk of adverse events according to the perioperative status of APT.

Conclusions

Surgical procedures were commonly performed after coronary stent implantation, and the risk of ischemic and bleeding complications in surgical procedures after DES was low, without any difference from that after BMS. Perioperative administration of dual-APT was not associated with lower risk for ischemic events.

Sources of Funding

This study was supported by the Pharmaceuticals and Medical Devices Agency (PMDA) in Japan.

Disclosures

Takeshi Kimura serves as an advisory board member for Cordis Cardiology, Abbott Vascular, and Terumo Company. The remaining authors reported no conflicts of interest.

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SUPPLEMENTAL MATERIAL

Supplemental Appendix A: List of participating centers and investigators for the CREDO-Kyoto PCI/CABG Registry Cohort-2

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Kitano Hospital: Ryuji Nohara

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Kokura Memorial Hospital: Masakiyo Nobuyoshi, Masashi Iwabuchi

Maizuru Kyosai Hospital: Ryozo Tatami

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Kobe City Medical Center General Hospital: Toru Kita, Yutaka Furukawa, Natsuhiko Ehara

Nishi-Kobe Medical Center: Hiroshi Kato, Hiroshi Eizawa

Kansai Denryoku Hospital: Katsuhisa Ishii

Osaka Red Cross Hospital: Masaru Tanaka

University of Fukui Hospital: Jong-Dae Lee, Akira Nakano

Shizuoka City Shizuoka Hospital: Akinori Takizawa

Hamamatsu Rosai Hospital: Masaaki Takahashi

Shiga University of Medical Science Hospital: Minoru Horie, Hiroyuki Takashima

Japanese Red Cross Wakayama Medical Center: Takashi Tamura

Shimabara Hospital: Mamoru Takahashi

Kagoshima University Medica and Dental Hospital: Chuwa Tei, Shuichi Hamasaki

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Kurashiki Central Hospital: Kazuaki Mitsudo, Kazushige Kadota

Mitsubishi Kyoto Hospital: Shinji Miki, Tetsu Mizoguchi

Kumamoto University Hospital: Hisao Ogawa, Seigo Sugiyama

Shimada Municipal Hospital: Ryuichi Hattori, Takeshi Aoyama, Makoto Araki

Juntendo University Shizuoka Hospital: Satoru Suwa

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Kobe City Medical Center General Hospital: Yukikatsu Okada, Michihiro Nasu

Osaka Red Cross Hospital: Shogo Nakayama

University of Fukui Hospital: Kuniyoshi Tanaka, Takaaki Koshiji, Koichi Morioka

Shizuoka City Shizuoka Hospital: Mitsuomi Shimamoto, Fumio Yamazaki

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Kumamoto University Hospital: Michio Kawasuji, Syuji Moriyama

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Research Institute for Production Development

Kumiko Kitagawa, Misato Yamauchi, Naoko Okamoto, Yumika Fujino, Saori Tezuka, Asuka Saeki, Miya Hanazawa, Yuki Sato, Chikako Hibi, Hitomi Sasae, Emi Takinami, Yuriko Uchida, Yuko Yamamoto, Satoko Nishida, Mai Yoshimoto, Sachiko Maeda, Izumi Miki, Saeko Minematsu.

Supplemental Appendix C: List of clinical event committee members

Mitsuru Abe (Kyoto Medical Center), Hiroki Shiomi (Kyoto University Hospital), Tomohisa Tada (Kyoto University Hospital), Junichi Tazaki (Kyoto University Hospital), Yoshihiro Kato (Kyoto University Hospital), Mamoru Hayano (Kyoto University Hospital), Akihiro Tokushige (Kyoto University Hospital), Masahiro Natsuaki (Kyoto University Hospital), Tetsu Nakajima (Kyoto University Hospital).

Supplemental Tables

Supplemental Table 1. Baseline Characteristics of Patients With Surgery versus Without Surgery During Follow-up After Coronary Stent Implantation

Variables	All patients N=12207	With surgery N=2398	Without surgery N=9809	p value
Clinical Characteristics				
Age (years)	68.3±11.0	70.0±9.6	67.8±11.3	<0.0001
Age >=75 years	3815 (31%)	839 (35%)	2976 (30%)	<0.0001
Male	8819 (72%)	1767 (74%)	7052 (72%)	0.08
BMI	23.6 (21.5-25.8)	23.5 (21.3-25.6)	23.6 (21.5-25.8)	0.02
BMI <25.0	8349 (68%)	1705 (70%)	6641 (68%)	0.1
Acute coronary syndrome	5157 (42%)	914 (38%)	4243 (43%)	<0.0001
Acute myocardial infarction	4317 (35%)	739 (31%)	3578 (36%)	<0.0001
Hypertension	10029 (82%)	2002 (84%)	8027 (82%)	0.06
Diabetes mellitus	4605 (38%)	1006 (42%)	3599 (37%)	<0.0001
On insulin therapy	933 (7.6%)	263 (11%)	670 (6.8%)	<0.0001
Current smoking	3889 (32%)	715 (30%)	3174 (32%)	0.02
Heart failure	2399 (20%)	580 (24%)	1819 (19%)	<0.0001
Shock at presentation	703 (5.8%)	155 (6.5%)	548 (5.6%)	0.1
Multivessel disease	6830 (56%)	1413 (59%)	5417 (55%)	0.001
Mitral regurgitation grade 3/4	470 (3.9%)	115 (4.8%)	355 (3.6%)	0.009
Ejection fraction	58.6±13.1	57.9±13.7	58.8±13.0	0.005
Prior myocardial infarction	1264 (10%)	293 (12%)	971 (9.9%)	0.001
Prior stroke	1299 (11%)	308 (13%)	991 (10%)	0.0001
Peripheral vascular disease	918 (7.5%)	348 (15%)	570 (5.8%)	<0.0001
eGFR <30, not on dialysis	493 (4.0%)	166 (6.9%)	327 (3.3%)	<0.0001
Dialysis	412 (3.4%)	139 (5.8%)	273 (2.8%)	<0.0001
Atrial fibrillation	1009 (8.3%)	247 (10%)	762 (7.8%)	<0.0001
Anemia (Hb <11.0g/dl)	1396 (11%)	404 (17%)	992 (10%)	<0.0001
Platelet $<100*10^9$/L	174 (1.4%)	38 (1.6%)	136 (1.4%)	0.5
COPD	442 (3.6%)	116 (4.8%)	326 (3.3%)	0.0006
Liver cirrhosis	313 (2.6%)	90 (3.8%)	223 (2.3%)	<0.0001

Malignancy	1112 (9.1%)	348 (15%)	764 (7.8%)	<0.0001
Lesion and Procedural Characteristics				
DES use	6802 (56%)	1295 (54%)	5507 (56%)	0.06
Number of target lesions	1 (1-2)	1 (1-2)	1 (1-2)	0.6
	1.49±0.77	1.5±0.77	1.49±0.77	
Target of proximal LAD	7196 (59%)	1384 (58%)	5812 (59%)	0.2
Target of unprotected LMCA	464 (3.8%)	104 (4.3%)	360 (3.7%)	0.13
Target of CTO	1325 (11%)	243 (10%)	1082 (11%)	0.2
Target of bifurcation	4110 (34%)	770 (32%)	3340 (34%)	0.07
Side-branch stenting	615 (5.0%)	119 (5.0%)	496 (5.1%)	0.8
Total number of stents	1(1-2)	1(1-2)	1(1-2)	0.4
	1.86±1.24	1.88±1.24	1.86±1.24	
Total stent length (mm)	28 (18-51)	28 (18-51)	28 (18-50)	0.7
	39.6±29.4	39.9±29.1	39.6±29.5	
Total stent length >28mm	5988 (49%)	1194 (50%)	4794 (49%)	0.4
Minimum stent size (mm)	3 (2.5-3)	3 (2.5-3)	3 (2.5-3)	0.7
	2.92±0.45	2.91±0.45	2.92±0.45	
Minimum stent size <3.0mm	5358 (44%)	1052 (44%)	4306 (44%)	1.0
Baseline Medications				
Antiplatelet therapy				
Thienopyridine	12081 (99%)	2366 (99%)	9715 (98.7%)	0.1
Ticlopidine	10896 (90%)	2199 (93%)	8697 (90%)	<0.0001
Clopidogrel	1156 (9.6%)	163 (6.9%)	993 (10%)	
Aspirin	12055 (99%)	2365 (99%)	9690 (99%)	0.5
Cilostazol	2379 (20%)	452 (19%)	1927 (20%)	0.4
Other medications				
Statins	6313 (52%)	1116 (47%)	5197 (53%)	<0.0001
Beta-blockers	3709 (30%)	720 (30%)	2989 (31%)	0.7
ACE-I/ARB	7160 (59%)	1356 (57%)	5804 (59%)	0.02
Nitrates	4366 (36%)	852 (36%)	3514 (36%)	0.8
Calcium channel blockers	4934 (40%)	1008 (42%)	3926 (40%)	0.07
Nicorandil	2895 (24%)	583 (24%)	2312 (24%)	0.5
Warfarin	960 (7.9%)	224 (9.3%)	736 (7.5%)	0.003
Proton pump inhibitors	3195 (26%)	665 (28%)	2530 (26%)	0.054
H2-blockers	3166 (26%)	568 (24%)	2598 (27%)	0.005

Continuous variables are shown as mean ± SD or median (Interquartile range).

ACE-I=angiotensin converting enzyme inhibitor, ARB=angiotensin receptor blocker, BMI=body mass index, BMS=bare-metal stents, COPD=chronic obstructive pulmonary disease, CTO=chronic total occlusion, DES=drug-eluting stents, eGFR=estimated glomerular filtration rate, Hb=hemoglobin, H2-blocker=histamine type 2 receptor blocker, LAD=left anterior descending coronary artery, LMCA=left main coronary artery, and PPI=proton pump inhibitor.

Supplemental Table 2. Independent Predictors for the Occurrence of Surgical Procedures within the First Year after Coronary Stent Implantation

Variables	Present	Absent	Univariate	p value	Multivariable	p value
	N of events /N of patients	N of events /N of patients	O.R. (95%C.I.)		O.R. (95%C.I.)	
DES use	575/6420	682/4886	0.61 (0.54-0.68)	<0.0001	0.52 (0.45-0.60)	<0.0001
Acute myocardial infarction	409/3833	848/7473	0.93 (0.82-1.06)	0.3	0.79 (0.67-0.93)	0.003
Peripheral vascular disease	243/846	1014/10460	3.75 (3.19-4.42)	<0.0001	3.22 (2.70-3.84)	<0.0001
Malignancy	216/998	1041/10308	2.46 (2.08-2.89)	<0.0001	2.11 (1.77-2.51)	<0.0001
Shock at presentation	121/495	1136/10811	2.76 (2.22-3.40)	<0.0001	1.92 (1.45-2.54)	<0.0001
Heart failure	356/1955	901/9351	2.09 (1.83-2.39)	<0.0001	1.49 (1.25-1.78)	<0.0001
Multivessel disease	785/6258	472/5048	1.39 (1.23-1.57)	<0.0001	1.4 (1.22-1.61)	<0.0001
Hemodialysis	82/348	1175/10958	2.57(1.98-3.30)	<0.0001	1.83(1.35-2.45)	0.0001
Anemia (Hb < 11.0g/dl)	243/1168	1014/10138	2.36 (2.02-2.76)	<0.0001	1.37 (1.14-1.66)	0.001
Insulin-treated diabetes	145/852	1112/10454	1.72 (1.42-2.08)	<0.0001	1.41 (1.14-1.73)	0.002
Male gender	942/8229	315/3077	1.13 (0.99-1.30)	0.07	1.23 (1.05-1.42)	0.007
Atrial fibrillation	145/892	1112/10414	1.62 (1.34-1.95)	<0.0001	1.32 (1.08-1.62)	0.008
Liver cirrhosis	59/291	1198/11015	2.08 (1.54-2.77)	<0.0001	1.55 (1.12-2.11)	0.009
Age >= 75	467/3341	790/7965	1.48 (1.31-1.67)	<0.0001	1.16 (1.01-1.33)	0.04
Target of proximal LAD	740/6663	517/4643	1.00 (0.89-1.12)	0.96	1.14 (1.00-1.3)	0.045

CI=confidence interval, DES=drug-eluting stents, Hb=hemoglobin, LAD=left anterior descending coronary artery, and OR=odds ratio.

Supplemental Table 3. Detailed Information about 7 Patients with Angiographically Documented Stent Thrombosis

	Patient 1	Patient 2	Patient 3	Patient 4	Patient 5	Patient 6	Patient 7
Age (years)	64	70	73	71	50	52	55
Sex	Female	Male	Male	Female	Male	Male	Male
Hypertension	Yes	Yes	Yes	No	Yes	Yes	No
Diabetes Mellitus	No	Yes	Yes	No	No	No	No
Current smoking	Yes	Yes	No	No	No	Yes	Yes
eGFR<30, not on dialysis	No	No	No	No	No	No	No
Dialysis	No	No	No	No	No	No	No
Indication for PCI	non-AMI	non-AMI	non-AMI	non-AMI	AMI	AMI	AMI
Stent type	SES only	SES and BMS	SES only	SES only	SES only	BMS only	BMS only
LVEF (%)	63	Unknown	46	49	58	65	48
N of target lesions	1	3	2	2	3	1	1
Target of proximal LAD	Yes	Yes	Yes	Yes	No	No	Yes
Target of unprotected LMCA	No	No	No	No	No	No	No
Target of CTO	No	Yes	No	Yes	No	No	No
Target of bifurcation	Yes	Yes	Yes	Yes	Yes	No	No
Side-branch stenting	No	Yes	No	No	Yes	No	No
Total number of stents	1	6	2	2	4	1	2
Total stent length (mm)	28	133	46	46	87	20	44
Minimum stent size (mm)	3	2.5	2.5	3	2.5	3.5	3
Days from PCI to Surgery	1107	30	70	703	11	0	6
Surgical Fields	Orthopedic	Dermatologic	Abdominal	Respiratory	Gastrointestinal endoscopy	Oral and maxillofacial	Gastrointestinal endoscopy
Anesthesia	General/Spinal	General/Spinal	General/Spinal	General/Spinal	General/Spinal	Local	Local
Status of perioperative APT	No	Single (Aspirin only)	No	No	Dual	Dual	Dual
Discontinuation interval before surgery (days)	Unknown	Unknown	Aspirin: 5 Clopidogrel: 11	Aspirin: 7 Ticlopidine: 708	0	0	0
ST vessel	LAD	LCX	LCX	LAD	LCX	RCA	LAD
Time from PCI to ST (days)	1114	31	78	704	12	0	14
Time from Surgery to ST (days)	7	1	8	1	1	0	8
ST timing	Very late	Late	Late	Very late	Subacute	Acute	Subacute

Death within 30 days after surgery	No	No	No	No	No	No	No
Ischemic events related to ST	MI	MI	MI	MI	MI	MI	UAP

AMI=acute myocardial infarction, APT=antiplatelet therapy, BMS=bare-metal stent, CTO=chronic total occlusion, eGFR=estimated glomerular filtration rate, LAD=left anterior descending coronary artery, LCX=left circumflex coronary artery, LMCA=left main coronary artery, MI=myocardial infarction, PCI=percutaneous coronary intervention, RCA=right coronary artery, SES=sirolimus-eluting stent, ST=stent thrombosis, and UAP=unstable angina pectoris.

Supplemental Table 4. Univariate and Multivariable Effects of DES-use and Perioperative APT for Ischemic Events within 30 Days after Surgical Procedures.

Variables	Present N of events /N of patients (incidence)	Absent N of events /N of patients (incidence)	Univariate H.R. (95%C.I.)	p value	Multivariable H.R. (95%C.I.)	p value
DES use	37/1295 (2.9%)	38/1103 (3.5%)	0.83 (0.53-1.31)	0.4	1.63 (0.93-2.87)	0.09
Within 42 days after PCI	34/355 (9.6%)	41/2043 (2.0%)	4.91 (3.10-7.72)	<0.0001	2.81 (1.52-5.15)	0.001
General/Spinal anesthesia	38/1056 (3.6%)	36/1293 (2.8%)	1.30 (0.82-2.05)	0.3	2.63 (1.47-4.73)	0.001
No APT	26/1160 (2.3%)	33/1025 (3.3%)	0.69 (0.41-1.15)	0.2	0.64 (0.33-1.23)	0.2
Single APT	5/444 (1.1%)	54/1741 (3.2%)	0.36 (0.13-0.82)	0.01	0.40 (0.13-1.01)	0.053
Acute myocardial infarction	43/739 (5.9%)	32/1659 (2.0%)	3.08 (1.96-4.91)	<0.0001	2.85 (1.52-5.30)	0.001
Age >= 75	39/839 (4.7%)	36/1559 (2.3%)	2.03 (1.29-3.21)	0.002	1.87 (1.10-3.20)	0.02
Male gender	53/1767 (3.0%)	22/631 (3.5%)	0.86 (0.53-1.44)	0.6		
BMI < 25.0	64/1670 (3.9%)	11/728 (1.5%)	2.56 (1.41-5.13)	0.001		
Multivessel disease	55/1413 (3.9%)	20/985 (2.1%)	1.93 (1.18-3.30)	0.008	2.13 (1.16-4.17)	0.01
Mitral regurgitation grade 3/4	5/115 (4.4%)	70/2283 (3.1%)	1.41 (0.50-3.17)	0.5		
Prior myocardial infarction	11/293 (3.8%)	64/2041 (3.1%)	1.24 (0.62-2.25)	0.5		
Shock at presentation	19/155 (12%)	56/2243 (2.5%)	5.14 (2.98-8.48)	<0.0001	1.39 (0.65-2.90)	0.4
Heart failure	37/580 (6.5%)	38/1818 (2.1%)	3.10 (1.97-4.88)	<0.0001		
Stroke	9/308 (3.0%)	66/2090 (3.2%)	0.94 (0.43-1.78)	0.9		
Atrial fibrillation	11/247 (4.5%)	64/2151 (3.0%)	1.51 (0.75-2.74)	0.2		
COPD	5/116 (4.4%)	70/2282 (3.1%)	1.41 (0.49-3.15)	0.5		
Malignancy	13/348 (3.8%)	62/2050 (3.1%)	1.23 (0.65-2.16)	0.5		
Peripheral vascular disease	8/348 (2.3%)	67/2050 (3.3%)	0.69 (0.31-1.36)	0.3		
Hemodialysis	7/139 (5.1%)	68/2259 (3.1%)	1.70 (0.71-3.44)	0.2		
eGFR<30, not on dialysis	8/166 (4.9%)	67/2232 (3.0%)	1.61 (0.71-3.15)	0.2		
Hypertension	55/2002 (2.8%)	20/396 (5.1%)	0.54 (0.33-0.92)	0.02		
Current smoking	19/715 (2.7%)	56/1683 (3.4%)	0.79 (0.46-1.31)	0.4		
Insulin-treated diabetes	6/263 (2.3%)	69/2135 (3.3%)	0.70 (0.27-1.48)	0.4		
Anemia (Hb < 11.0g/dl)	23/404 (5.8%)	52/1994 (2.6%)	2.20 (1.32-3.55)	0.003	1.71 (0.94-3.02)	0.08
Platelet <100*10^9/L*	2/38 (5.3%)	73/2360 (3.1%)	1.70 (0.28-5.39)	0.5		
Target of proximal LAD	43/1384 (3.2%)	32/1014 (3.2%)	0.98 (0.62-1.56)	0.9		
Target of LMCA	8/104 (7.8%)	67/2294 (3.0%)	2.67 (1.18-5.23)	0.02		
Target of CTO	9/243 (3.7%)	66/2155 (3.1%)	1.22 (0.56-2.31)	0.6		

Target of bifurcation	28/770 (3.7%)	47/1628 (2.9%)	1.26 (0.78-2.00)	0.3		
Two-stent for bifurcation	3/119 (2.6%)	72/2279 (3.2%)	0.80 (0.20-2.14)	0.7		
Total stent length >=28mm	38/1194 (3.2%)	37/1204 (3.1%)	1.03 (0.66-1.63)	0.9		
Minimal stent size < 3.0mm	37/1052 (3.6%)	38/1346 (2.9%)	1.25 (0.79-1.97)	0.3		
Baseline medications						
Cilostazol	15/452 (3.4%)	60/1946 (3.1%)	1.09 (0.59-1.86)	0.8		
Statins	20/1116 (1.8%)	55/1282 (4.4%)	0.41 (0.24-0.68)	0.0003	0.47 (0.24-0.85)	0.01
ACE-I/ARB	33/1356 (2.5%)	42/1042 (4.1%)	0.60 (0.38-0.95)	0.03	0.59 (0.34-1.00)	0.052
Beta blockers	17/720 (2.4%)	58/1678 (3.5%)	0.68 (0.38-1.13)	0.1		
Calcium channel blockers	16/1008 (1.6%)	59/1390 (4.3%)	0.37 (0.21-0.62)	0.0001	0.44 (0.22-0.82)	0.009
Nitrates	18/852 (2.2%)	57/1546 (3.7%)	0.57 (0.33-0.95)	0.03		
Nicorandil	17/583 (2.9%)	58/1815 (3.2%)	0.90 (0.51-1.52)	0.7		
Proton pump inhibitors	23/665 (3.5%)	52/1733 (3.0%)	1.15 (0.69-1.86)	0.6		
H2 blokers	13/568 (2.3%)	62/1830 (3.4%)	0.68 (0.36-1.19)	0.2		
Warfarin	8/224 (3.6%)	67/2174 (3.1%)	1.17 (0.52-2.30)	0.7		

ACE-I=angiotensin converting enzyme inhibitor, APT=antiplatelet therapy, ARB=angiotensin receptor blocker, BMI=body mass index, BMS=bare-metal stents, CI=confidence interval, COPD=chronic obstructive pulmonary disease, CTO=chronic total occlusion, DES=drug-eluting stents, eGFR=estimated glomerular filtration rate, Hb=hemoglobin, HR=hazard ratio, H2-blocker=histamine type 2 receptor blocker, LAD=left anterior descending coronary artery, LMCA=left main coronary artery, PCI=percutaneous coronary intervention, and PPI=proton pump inhibitor.

Supplemental Table 5. Univariate and Multivariable Effects of DES-use and Perioperative APT for Bleeding Events within 30 Days after Surgical Procedures.

Variables	Present N of events /N of patients (incidence)	Absent N of events /N of patients (incidence)	Univariate H.R. (95%C.I.)	p value	Multivariable H.R. (95%C.I.)	p value
DES use	27/1295 (2.1%)	33/1103 (3.2%)	0.69 (0.41-1.15)	0.2	0.60 (0.34-1.06)	0.08
Within 42 days after PCI	22/355 (6.7%)	38/2043 (1.9%)	3.53 (2.06-5.91)	<0.0001	2.34 (1.27-4.23)	0.007
General/Spinal anesthesia	32/1056 (3.1%)	27/1293 (2.2%)	1.44 (0.86-2.42)	0.2	1.87 (1.04-3.39)	0.04
No APT	27/1160 (2.4%)	29/1025 (3.0%)	0.80 (0.47-1.36)	0.4	0.64 (0.33-1.27)	0.2
Single APT	7/444 (1.6%)	49/1741 (2.9%)	0.55 (0.23-1.14)	0.1	0.59 (0.22-1.42)	0.2
Acute myocardial infarction	24/739 (3.4%)	36/1659 (2.2%)	1.53 (0.90-2.55)	0.1		
Age >= 75	25/839 (3.1%)	35/1559 (2.3%)	1.35 (0.80-2.24)	0.3		
Male gender	40/1767 (2.4%)	20/631 (3.3%)	0.71 (0.42-1.24)	0.2		
BMI < 25.0	42/1670 (2.6%)	18/728 (2.6%)	1.03 (0.60-1.83)	0.9		
Multivessel disease	43/1413 (3.2%)	17/985 (1.8%)	1.78 (1.04-3.21)	0.04		
Mitral regurgitation grade 3/4	8/115 (7.2%)	52/2283 (2.4%)	3.14 (1.38-6.24)	0.009	1.87 (0.75-3.99)	0.2
Prior myocardial infarction	9/293 (3.2%)	51/2105 (2.5%)	1.27 (0.58-2.45)	0.5		
Shock at presentation	10/155 (7.2%)	50/2243 (2.3%)	3.05 (1.46-5.75)	0.005		
Heart failure	30/580 (5.4%)	30/1818 (1.7%)	3.22 (1.94-5.36)	<0.0001	2.09 (1.18-3.66)	0.01
Stroke	9/308 (3.1%)	51/2090 (2.5%)	1.21 (0.56-2.34)	0.6		
Atrial fibrillation	7/247 (3.0%)	53/2151 (2.6%)	1.16 (0.48-2.39)	0.7		
COPD	1/116 (0.9%)	59/2282 (2.7%)	0.33 (0.02-1.51)	0.2		
Malignancy	8/348 (2.4%)	52/2050 (2.7%)	0.90 (0.39-1.78)	0.8		
Peripheral vascular disease	12/348 (3.6%)	48/2050 (2.4%)	1.47 (0.74-2.67)	0.3		
Hemodialysis	9/139 (6.9%)	51/2259 (2.4%)	2.97 (1.36-5.73)	0.008		
eGFR<30, not on dialysis	7/166 (4.4%)	53/2232 (2.5%)	1.79 (0.74-3.69)	0.2		
Hypertension	52/2002 (2.7%)	8/396 (2.1%)	1.28 (0.65-2.92)	0.5		
Current smoking	22/715 (3.2%)	38/1683 (2.4%)	1.36 (0.79-2.28)	0.3		
Insulin-treated diabetes	16/263 (6.3%)	44/2135 (2.1%)	2.94 (1.61-5.10)	0.00008	3.17 (1.7-5.66)	0.0005
Anemia (Hb < 11.0g/dl)	16/404 (4.1%)	44/1994 (2.3%)	1.84 (1.01-3.19)	0.047		
Platelet <100*10^9/L*	1/38 (2.9%)	59/2360 (2.6%)	1.09 (0.06-4.95)	0.9		
Target of proximal LAD	37/1384 (2.8%)	23/1014 (2.4%)	1.18 (0.71-2.02)	0.5		
Target of LMCA	7/104 (7.0%)	53/2294 (2.4%)	2.99 (1.24-6.14)	0.02	2.25 (0.84-5.04)	0.1

Target of CTO	6/243 (2.6%)	54/2155 (2.6%)	0.98 (0.38-2.11)	1.0
Target of bifurcation	24/770 (3.3%)	36/1628 (2.3%)	1.43 (0.84-2.39)	0.2
Two-stent for bifurcation	2/119 (1.7%)	58/2279 (2.7%)	0.67 (0.11-2.13)	0.5
Total stent length >=28mm	34/1194 (3.0%)	26/1204 (2.3%)	1.32 (0.79-2.21)	0.3
Minimal stent size < 3.0mm	26/1052 (2.6%)	34/1346 (2.6%)	0.99 (0.59-1.65)	1.0
Baseline medications				
Cilostazol	11/452 (2.5%)	49/1946 (2.6%)	0.97 (0.48-1.79)	0.9
Statins	27/1116 (2.5%)	33/1282 (2.7%)	0.92 (0.55-1.53)	0.8
ACE-I/ARB	34/1356 (2.6%)	26/1042 (2.6%)	1.00 (0.60-1.68)	1.0
Beta blockers	23/720 (3.3%)	37/1678 (2.3%)	1.45 (0.85-2.43)	0.2
Calcium channel blockers	25/1008 (2.6%)	35/1390 (2.6%)	0.97 (0.57-1.61)	0.9
Nitrates	19/852 (2.3%)	41/1546 (2.8%)	0.83 (0.47-1.41)	0.5
Nicorandil	18/583 (3.2%)	42/1815 (2.4%)	1.32 (0.74-2.25)	0.3
Proton pump inhibitors	20/665 (3.1%)	40/1733 (2.4%)	1.30 (0.75-2.20)	0.3
H2 blokers	12/568 (2.2%)	48/1830 (2.7%)	0.80 (0.40-1.45)	0.5
Warfarin	6/224 (2.8%)	54/2174 (2.6%)	1.08 (0.42-2.31)	0.9

ACE-I=angiotensin converting enzyme inhibitor, APT=antiplatelet therapy, ARB=angiotensin receptor blocker, BMI=body mass index, BMS=bare-metal stents, CI=confidence interval, COPD=chronic obstructive pulmonary disease, CTO=chronic total occlusion, DES=drug-eluting stents, eGFR=estimated glomerular filtration rate, Hb=hemoglobin, HR=hazard ratio, H2-blocker=histamine type 2 receptor blocker, LAD=left anterior descending coronary artery, LMCA=left main coronary artery, PCI=percutaneous coronary intervention, and PPI=proton pump inhibitor.

Supplemental Table 6. Baseline Characteristics According to the Status of Perioperative APT

Variables	Dual APT N=581	No APT N=1160	Single APT N=444	p value
Clinical characteristics				
Age (years)	70.3±10.2	69.6±9.1	70.5±10.1	0.1
Age >=75 years	224 (39%)	364 (31%)	166 (37%)	0.004
Male	419 (72%)	913 (79%)	299 (67%)	<00001
BMI	23.4 (21.1-25.5)	23.7 (21.5-25.7)	23.4 (20.8-25.7)	0.1
BMI <25.0	419 (72%)	786 (68%)	313 (71%)	0.2
Acute coronary syndrome	229 (39%)	429 (37%)	182 (41%)	0.3
Acute myocardial infarction	187 (32%)	347 (30%)	147 (33%)	0.4
Hypertension	490 (84%)	960 (83%)	371 (84%)	0.7
Diabetes mellitus	283 (49%)	452 (39%)	185 (42%)	0.0005
On insulin therapy	85 (15%)	116 (10%)	41 (9.2%)	0.007
Current smoking	174 (30%)	358 (31%)	123 (28%)	0.5
Heart failure	182 (31%)	249 (21%)	93 (21%)	<0.0001
Shock at presentation	54 (9.3%)	59 (5.1%)	29 (6.5%)	0.005
Multivessel disease	384 (66%)	662 (57%)	246 (55%)	0.0003
Mitral regurgitation grade 3/4	37 (6.4%)	51 (4.4%)	15 (3.4%)	0.07
Ejection fraction	55.5±14.8	58.8±12.9	57.6±14.0	0.0001
Prior myocardial infarction	88 (15%)	134 (12%)	50 (11%)	0.08
Prior stroke	105 (18%)	130 (11%)	50 (11%)	0.0002
Peripheral vascular disease	68 (12%)	196 (17%)	49 (11%)	0.001
eGFR <30, not on dialysis	65 (11%)	56 (4.8%)	27 (6.1%)	<0.0001
Dialysis	48 (8.3%)	56 (4.8%)	19 (4.3%)	0.008
Atrial fibrillation	52 (9.0%)	123 (11%)	46 (10%)	0.5
Anemia (Hb <11.0g/dl)	135 (23%)	157 (14%)	67 (15%)	<0.0001
Platelet $<100*10^9$/L	11 (1.9%)	16 (1.4%)	7 (1.6%)	0.7
COPD	27 (4.7%)	53 (4.6%)	19 (4.3%)	1.0
Liver cirrhosis	31 (5.3%)	30 (2.6%)	17 (3.8%)	0.02
Malignancy	73 (13%)	202 (17%)	50 (11%)	0.001
Lesion and Procedural Characteristics				
DES use	414 (71%)	546 (47%)	233 (52%)	<0.0001
Number of target lesions	1 (1-2)	1 (1-2)	1 (1-2)	<0.0001
	1.64±0.84	1.46±0.74	1.45±0.77	

Target of proximal LAD	356 (61%)	656 (57%)	266 (60%)	0.1
Target of unprotected LMCA	46 (7.9%)	37 (3.2%)	14 (3.2%)	<0.0001
Target of CTO	65 (11%)	120 (10%)	41 (9.2%)	0.6
Target of bifurcation	221 (38%)	361 (31%)	144 (32%)	0.02
Side-branch stenting	41 (7.1%)	50 (4.3%)	26 (5.9%)	0.052
Total number of stents	2 (1-3)	1 (1-2)	1 (1-2)	<0.0001
	2.14±1.42	1.80±1.17	1.83±1.2	
Total stent length (mm)	36 (23-60)	28 (18-49)	28 (18-47)	<0.0001
	45.9±33.2	38.2±27.8	38.0±27.5	
Total stent length >28mm	346 (60%)	535 (46%)	214 (48%)	<0.0001
Minimum stent size (mm)	2.75 (2.5-3)	3 (2.5-3)	3 (2.5-3)	<0.0001
	2.84±0.41	2.94±0.45	2.91±0.45	
Minimum stent size <3.0mm	296 (51%)	485 (42%)	193 (44%)	0.001
Baseline Medications				
Antiplatelet therapy				
Thienopyridine	579 (99.7%)	1150 (99.1%)	443 (99.8%)	0.2
Ticlopidine	526 (91%)	1082 (94%)	411 (93%)	0.047
Clopidogrel	52 (9.0%)	66 (5.8%)	31 (7.0%)	
Aspirin	580 (99.8%)	1158 (99.8%)	444 (100%)	0.5
Cilostazol	112 (19%)	219 (19%)	86 (19%)	1.0
Other medications				
Statins	273 (47%)	528 (46%)	214 (48%)	0.6
Beta-blockers	201 (35%)	311 (27%)	146 (33%)	0.001
ACE-I/ARB	332 (57%)	654 (56%)	251 (57%)	1.0
Nitrates	193 (33%)	429 (37%)	160 (36%)	0.3
Calcium channel blockers	238 (41%)	503 (43%)	177 (40%)	0.4
Nicorandil	159 (27%)	269 (23%)	112 (25%)	0.2
Warfarin	49 (8.4%)	112 (9.7%)	43 (9.7%)	0.7
Proton pump inhibitors	191 (33%)	311 (27%)	113 (25%)	0.01
H2-blockers	118 (20%)	289 (25%)	102 (23%)	0.1
Factors related to surgery				
Surgery within 42 days	168 (29%)	130 (11%)	29 (6.5%)	<0.0001
General/Spinal anesthesia	107 (19%)	711 (62%)	153 (35%)	<0.0001

ACE-I=angiotensin converting enzyme inhibitor, APT=antiplatelet therapy, ARB=angiotensin

receptor blocker, BMI=body mass index, COPD=chronic obstructive pulmonary disease, CTO=chronic total occlusion, DES=drug-eluting stents, eGFR=estimated glomerular filtration rate, H2-blocker=histamine type2 receptor blocker, LAD=left anterior descending coronary artery, and LMCA=left main coronary artery.

Supplemental Table 7. Adverse event rates at 30 days after surgical procedures according to the status of perioperative APT

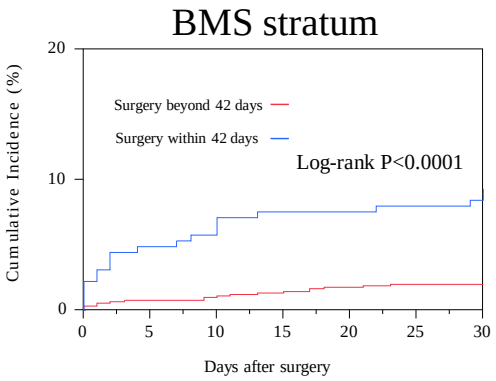
Endpoints	N of events (incidence)			
	Dual APT	No APT	Single APT	p value
Death/MI/ST (definite or probable)	28 (4.9%)	26 (2.3%)	5 (1.1%)	0.005
Death	23 (4.0%)	24 (2.1%)	4 (0.9%)	0.004
Cardiac Death	17 (3.0%)	14 (1.2%)	1 (0.2%)	0.0004
Non-cardiac Death	6 (1.1%)	10 (0.9%)	3 (0.7%)	0.8
MI	5 (0.9%)	5 (0.4%)	1 (0.2%)	0.3
ST (definite or probable)	3 (0.5%)	5 (0.4%)	1 (0.2%)	0.8
Bleeding	22 (4.0%)	27 (2.4%)	7 (1.6%)	0.047

APT=antiplatelet therapy, MI=myocardial infarction, and ST=stent thrombosis.

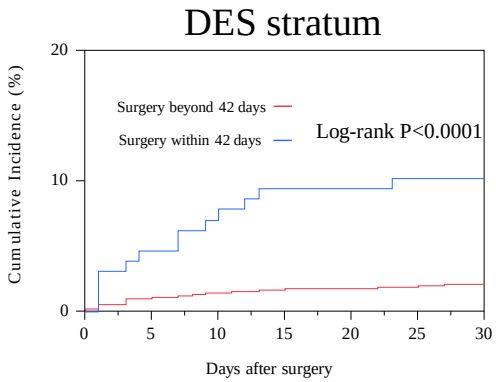
Supplemental Figure

Supplemental Figure 1.

(A) Death/MI/ST

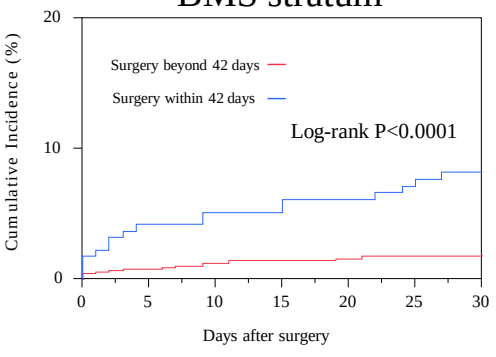


Surgery within 42 days	Baseline	7 Days	30 Days
Incidence		5.3%	9.3%
Number of events		12	21
Number of patients at risk	227	215	206
Surgery beyond 42 days			
Incidence		0.8%	2.0%
Number of events		7	17
Number of patients at risk	876	860	821

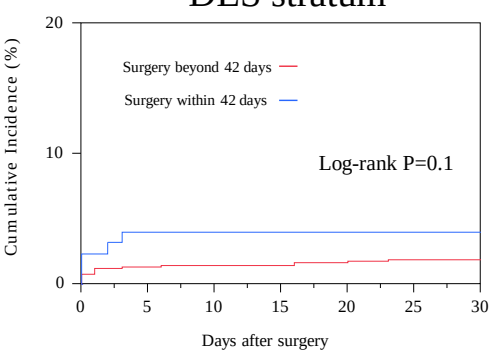


Surgery within 42 days	Baseline	7 Days	30 Days
Incidence		6.3%	10.2%
Number of events		8	13
Number of patients at risk	128	121	114
Surgery beyond 42 days			
Incidence		1.2%	2.1%
Number of events		14	24
Number of patients at risk	1167	1140	1088

(B) Bleeding

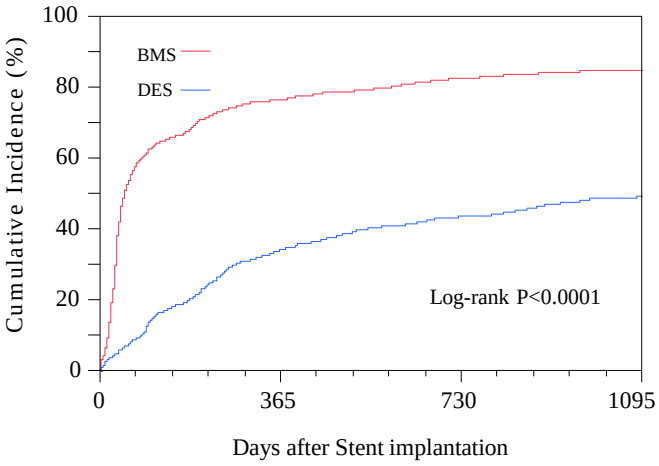


Surgery within 42 days	Baseline	7 Days	30 Days
Incidence		4.2%	8.2%
Number of events		9	17
Number of patients at risk	227	197	182
Surgery beyond 42 days			
Incidence		1.1%	1.9%
Number of events		9	16
Number of patients at risk	876	828	785



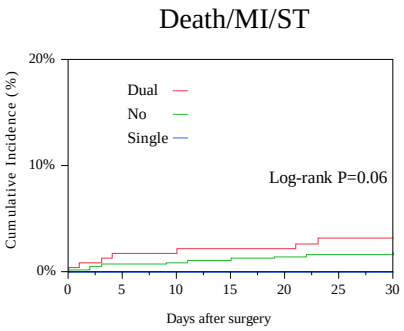
Surgery within 42 days	Baseline	7 Days	30 Days
Incidence		4.0%	4.0%
Number of events		5	5
Number of patients at risk	128	111	105
Surgery beyond 42 days			
Incidence		1.5%	1.9%
Number of events		17	22
Number of patients at risk	1167	1104	1050

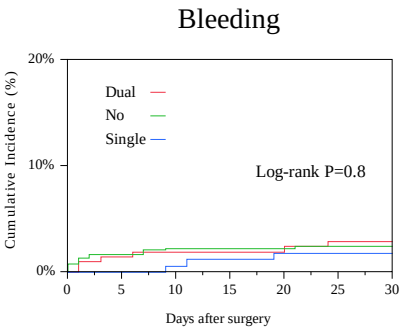
Supplemental Figure 2.



BMS	Baseline	30 Days	1 year	2 years	3 years
Incidence		32%	77%	83%	85%
Number of events		345	826	883	898
Number of patients at risk	1103	765	234	137	70
DES					
Incidence		4.9%	34%	44%	50%
Number of events		63	433	544	592
Number of patients at risk	1295	1222	812	570	287

Supplemental Figure 3.





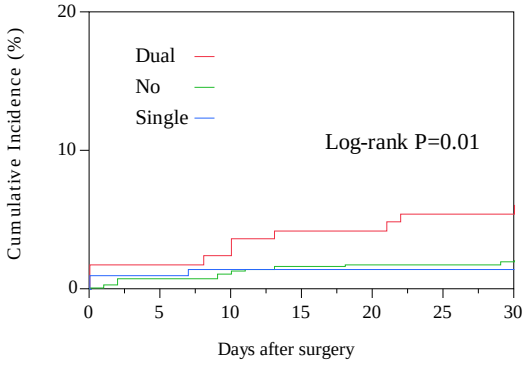
Dual APT			
	Baseline	7 Days	30 Days
Incidence		1.8%	3.2%
Number of events		4	7
Number of patients at risk	221	218	211
No APT			
Incidence		0.7%	1.9%
Number of events		4	10
Number of patients at risk	537	533	525
Single APT			
Incidence		0.0%	0.0%
Number of events		0	0
Number of patients at risk	176	176	176

Dual APT			
	Baseline	7 Days	30 Days
Incidence		1.9%	2.9%
Number of events		4	6
Number of patients at risk	221	202	195
No APT			
Incidence		2.1%	2.5%
Number of events		11	13
Number of patients at risk	537	517	506
Single APT			
Incidence		0.0%	1.8%
Number of events		0	3
Number of patients at risk	176	176	168

Supplemental Figure 4.

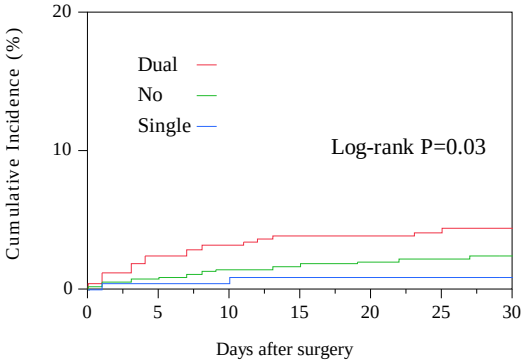
(A) Death/MI/ST

BMS stratum



	Baseline	7 Days	30 Days
Dual APT			
Incidence		1.8%	6.1%
Number of events		3	10
Number of patients at risk	167	163	151
No APT			
Incidence		0.8%	2.1%
Number of events		7	13
Number of patients at risk	614	603	581
Single APT			
Incidence		1.4%	1.4%
Number of events		3	3
Number of patients at risk	211	207	198

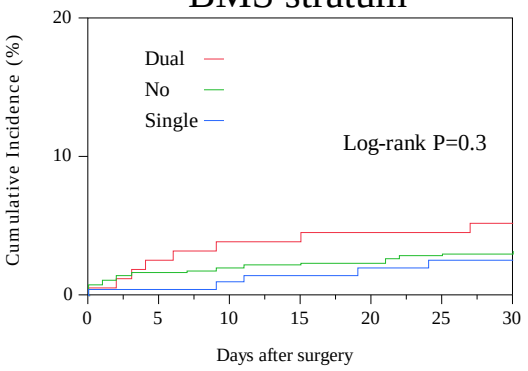
DES stratum



	Baseline	7 Days	30 Days
Dual APT			
Incidence		2.9%	4.4%
Number of events		12	18
Number of patients at risk	414	396	383
No APT			
Incidence		1.1%	2.4%
Number of events		6	13
Number of patients at risk	546	537	507
Single APT			
Incidence		0.4%	0.9%
Number of events		1	2
Number of patients at risk	233	229	218

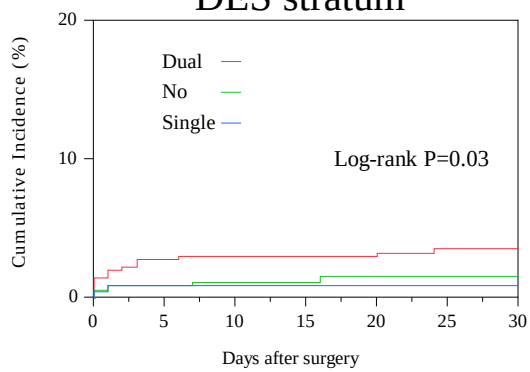
(B) Bleeding

BMS stratum



	Baseline	7 Days	30 Days
Dual APT			
Incidence		3.2%	5.3%
Number of events		5	8
Number of patients at risk	167	147	134
No APT			
Incidence		1.8%	3.2%
Number of events		11	19
Number of patients at risk	614	578	549
Single APT			
Incidence		0.5%	2.5%
Number of events		1	5
Number of patients at risk	211	201	189

DES stratum



	Baseline	7 Days	30 Days
Dual APT			
Incidence		3.0%	3.5%
Number of events		12	14
Number of patients at risk	414	368	356
No APT			
Incidence		1.1%	1.5%
Number of events		6	8
Number of patients at risk	546	526	495
Single APT			
Incidence		0.9%	0.9%
Number of events		2	2
Number of patients at risk	233	225	214

Supplemental Figure Legends

Supplemental Figure 1. Cumulative incidence of death/MI/ST (A) and bleeding (B) within 30 days after surgical procedures in the BMS and DES strata; early versus late surgical procedures.

BMS=bare-metal stents, DES=drug-eluting stents, MI=myocardial infarction, and ST=stent thrombosis.

Supplemental Figure 2. Cumulative incidences of persistent discontinuation of thienopyridines: BMS versus DES. Persistent discontinuation was defined as withdrawal lasting at least 2 months.

BMS=bare-metal stent, and DES=drug-eluting stent.

Supplemental Figure 3. Cumulative incidence of death/MI/ST and bleeding within 30 days after surgical procedures according to the status of perioperative APT in patients who underwent surgical procedures in the interval between 31 days and 1 year after index PCI procedure.

APT=antiplatelet therapy, MI=myocardial infarction, and ST=stent thrombosis.

Supplemental Figure 4.

Cumulative incidence of death/MI/ST (A) and bleeding (B) within 30 days after surgical procedures in the BMS and DES strata according to the status of perioperative APT.

APT=antiplatelet therapy, BMS=bare-metal stents, DES=drug-eluting stents, MI=myocardial infarction, and ST=stent thrombosis.