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# 'Real World' Comparison of Drug-Eluting Stents vs Bare Metal Stents in the Treatment of Unselected Patients With Acute ST-Segment Elevation Myocardial Infarction

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***Background:*** Concerns exist regarding the long-term efficacy and safety of drug-eluting stents (DES) in patients with ST-segment elevation myocardial infarction (STEMI). The study aimed to compare the mid- to long-term outcomes of DES vs bare metal stents (BMS) in patients with STEMI in a real-world setting.

***Methods and Results:*** Six hundred and eighty four consecutive patients with STEMI who underwent percutaneous coronary intervention from January 2003 to December 2006 were analyzed; 539 patients (78.8%) with DES and 145 (21.2%) with BMS. Patients were followed for the occurrence of target vessel failure (TVF); a composite of cardiac death, non-fatal myocardial infarction, or target vessel revascularization (TVR). After a follow-up duration of 36 months, the TVF rate was significant lower in the DES group compared with the BMS group (17.8% vs 34.5%, P<0.01), which was mainly driven by a decrease in TVR (9.1% vs 22.8%, P<0.01). Diabetic patients, those with multivessel disease and those treated with smaller or longer stents benefited more from DES implantation. Propensity score matching concordantly indicated a benefit of DES with regard to TVF (13.5% vs 34.2%; P<0.01). The overall incidence of stent thrombosis (ST) in each group was comparable (3.9% vs 4.1%, P=0.47).

***Conclusions:*** Compared to BMS, the mid- to long-term outcome was better in patients receiving DES for acute STEMI. This was driven mainly by a reduction in repeat revascularization. (*Circ J* 2010; **74:** 1111–1120)

**Key Words:** Drug-eluting stents; Myocardial infarction; Percutaneous coronary intervention (PCI)

Drug-eluting stents (DES) have significantly reduced the need for repeat revascularization procedures after percutaneous coronary intervention (PCI) owing to decreased late luminal loss and angiographic restenosis.[1,2] Since their introduction, DES have rapidly substituted bare metal stents (BMS) in the treatment of various coronary artery lesions, including the treatment of ST-segment elevation myocardial infarction (STEMI).

Primary angioplasty with coronary stenting has become the standard treatment for STEMI;[3] however, long-term data on the efficacy and safety of DES in this clinical setting are still limited. Due to the increased incidence of very late stent thrombosis (ST) and the need for prolonged dual antiplatelet therapy (DAT) after DES use,[4–8] questions have recently been raised regarding the long-term efficacy and safety of DES in the treatment of patients with acute STEMI.

A few randomized prospective clinical trials have compared the outcome of DES vs BMS in patients with STEMI,[9–15] where sirolimus-eluting stents (SES) showed a decrease in the need for target vessel revascularization (TVR) in a study that mandated angiographic follow up, while paclitaxel-eluting stents (PES) did not show a significant benefit in a study that did not mandate angiographic follow up. In these studies, the incidence of ST did not differ between DES and BMS. However, the populations studied in these trials were selected patients, which limited its generalization to 'real-world'

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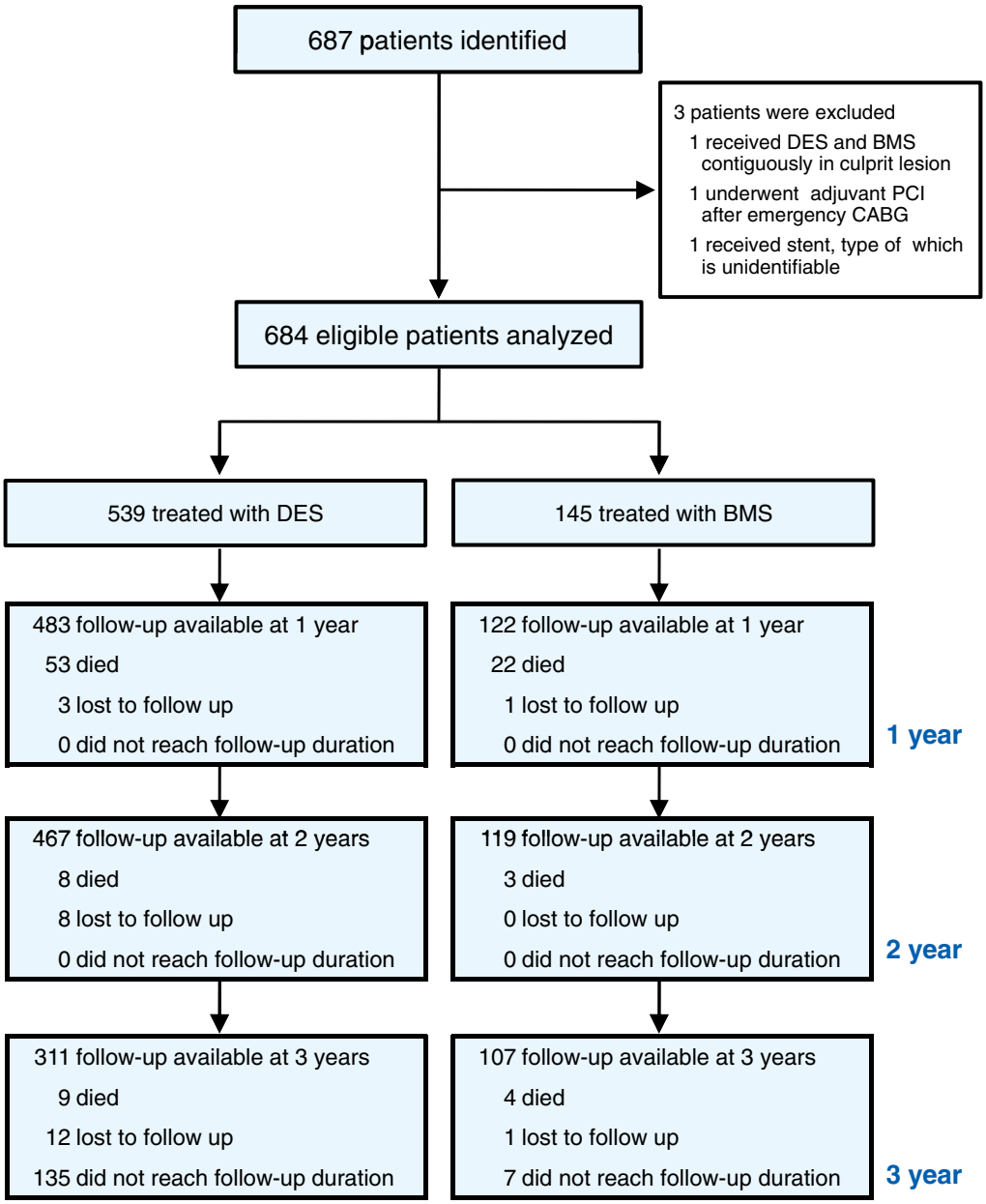


**Figure 1.** Follow sheet of patients during follow up. DES, drug-eluting stents; BMS, bare metal stents; PCI, percutaneous coronary intervention.

STEMI patients receiving PCI. Furthermore, we still lack long-term data on the efficacy and safety of DES. The present study aimed to assess the "real-world" mid- to long-term outcome of DES compared with that of BMS in unselected patients with STEMI.

## Methods

Detailed study methods are available in the supplementary file. In brief, we analyzed consecutive 684 patients who underwent coronary angioplasty with stenting for STEMI from a 2-center registry (Seoul National University Main and Bundang Hospital, Korea) from January 2003 to December 2006. Patients received a coronary angiography and intervention following the current standard techniques. The type of stent to be implanted was decided by the operator during the procedure. This protocol was approved by the local Institutional Review Board and is in accordance with the Declaration of Helsinki. Informed consent was obtained from all patients at the time of admission for treatment of STEMI. Study patients were followed up to 3 years. The primary outcome endpoint was the occurrence of target vessel failure (TVF): a composite of cardiac death, non-fatal myocardial infarction (MI), or TVR. ST was defined as 'definite' or 'probable' according to the Academic Research Consortium's definition.[16] In order to reduce potential confounding factors of

**Table 1. Baseline Characteristics of Crude Study Patients**

| Characteristics | DES (n=539) | BMS (n=145) | P value* |
|---|---|---|---|
| **Demographic characteristics** | | | |
| Male sex, no (%) | 394 (73.1) | 113 (77.9) | 0.24 |
| Age, years | 61.9±12.8 | 62.4±12.5 | 0.68 |
| Hypertension, no (%) | 282 (52.3) | 71 (49.0) | 0.47 |
| Diabetes mellitus, no (%) | 148 (27.5) | 42 (29.0) | 0.72 |
| Smoking, no (%) | 235 (43.6) | 57 (39.3) | 0.35 |
| Dyslipidemia, no (%) | 236 (43.8) | 33 (22.8) | <0.01 |
| Chronic kidney disease, no (%) | 36 (6.7) | 11 (7.6) | 0.59 |
| Pain-to-balloon time, h** | 4.9 (3.3–8.0) | 4.7 (3.1–7.9) | 0.83 |
| Door-to-balloon time, min** | 97 (64–134) | 98 (63–153) | 0.59 |
| Cardiogenic shock at admission, no (%) | 93 (17.3) | 32 (22.1) | 0.18 |
| Clinical indications, no (%) | | | 0.68 |
| Emergency PCI | 398 (73.8) | 103 (71.0) | |
| Rescue PCI | 7 (1.3) | 3 (2.1) | |
| Elective PCI | 134 (24.9) | 39 (26.9) | |
| Ejection fraction, % | 49±13 | 48±11 | 0.78 |
| Peak CK-MB, mg/dl | 253.5±236.1 | 202.3±228.6 | 0.35 |
| LDL cholesterol, mg/dl | 109±34 | 107±34 | 0.73 |
| $HbA_{1c}$, % | 6.9±1.6 | 7.4±2.4 | 0.36 |
| Follow-up duration, months | 24.8±13.4 | 35.0±19.7 | <0.01 |
| **Angiographic & Procedural characteristics** | | | |
| Infarct-related artery, no (%) | | | 0.09 |
| Left anterior descending coronary artery | 304 (56.4) | 72 (49.7) | |
| Left circumflex coronary artery | 53 (9.8) | 12 (8.3) | |
| Right coronary artery | 174 (32.3) | 61 (42.1) | |
| Left main stem | 8 (1.5) | 0 (0.0) | |
| Number of disease vessels, no (%) | | | 0.53 |
| Single vessel disease | 198 (36.7) | 55 (37.9) | |
| 2 vessel disease | 190 (35.3) | 56 (38.6) | |
| 3 vessel disease | 151 (28.0) | 34 (23.4) | |
| Infarction of previously revascularized vessel, no (%) | 13 (2.4) | 4 (2.8) | 0.77 |
| Maximal stent diameter, mm | 3.1±0.4 | 3.3±0.6 | <0.01 |
| Total stented length, mm | 28.4±11.2 | 24.2±8.5 | <0.01 |
| Glycoprotein IIb/IIIa inhibitors, no (%) | 74 (13.7) | 18 (12.4) | 0.68 |
| **Medications at discharge** | | | |
| ACE inhibitor, no (%) | 253 (46.9) | 63 (43.4) | 0.45 |
| Angiotensin II-receptor antagonist, no (%) | 146 (27.1) | 34 (23.4) | 0.38 |
| $\beta$-blocker, no (%) | 268 (49.7) | 73 (50.3) | 0.89 |
| Calcium channel blocker, no (%) | 56 (10.4) | 17 (11.7) | 0.64 |
| Statin, no (%) | 371 (68.8) | 74 (51.0) | <0.01 |
| Duration of DAT, months | 12.9±9.3 | 12.9±12.2 | 0.99 |

*P value by $\chi^2$ test for categorical variables or Student's t-test for continuous variables.
**Time intervals are compared only for the cases of primary PCI.
DES, drug-eluting stent; BMS, bare metal stent; PCI, percutaneous coronary intervention; LDL, low-density lipoprotein; ACE, angiotensin-converting enzyme; DAT, dual antiplatelet therapy.

observational study, we adopted multivariable-adjusted and propensity score-adjusted models. The details of statistical models are described in the supplementary file.

## Results

### Characteristics of the Study Populations

Among a total of 684 patients that received PCI for STEMI during the study period, 539 patients (78.8%) were treated with DES, and 145 (21.2%) with BMS. Figure 1 shows the flow of patients according to the follow-up period. BMS was used more often earlier in the study period, while DES penetration increased rapidly after its introduction in 2003 (Figure S2). Table 1 shows a comparison of baseline characteristics for the 2 groups. Clinical features of the 2 groups were mostly comparable, while the right coronary artery was more frequently the culprit vessel in the BMS group, and dyslipidemia was more common in the DES group. Procedural characteristics did not differ significantly between the 2 groups, except for the smaller stent diameter and longer length in the DES group. In the DES group, SES were implanted in 391 patients (72.5%), PES in 123 (22.8%), and zotarolimus-eluting stents in 25 (4.6%) (Table S3).

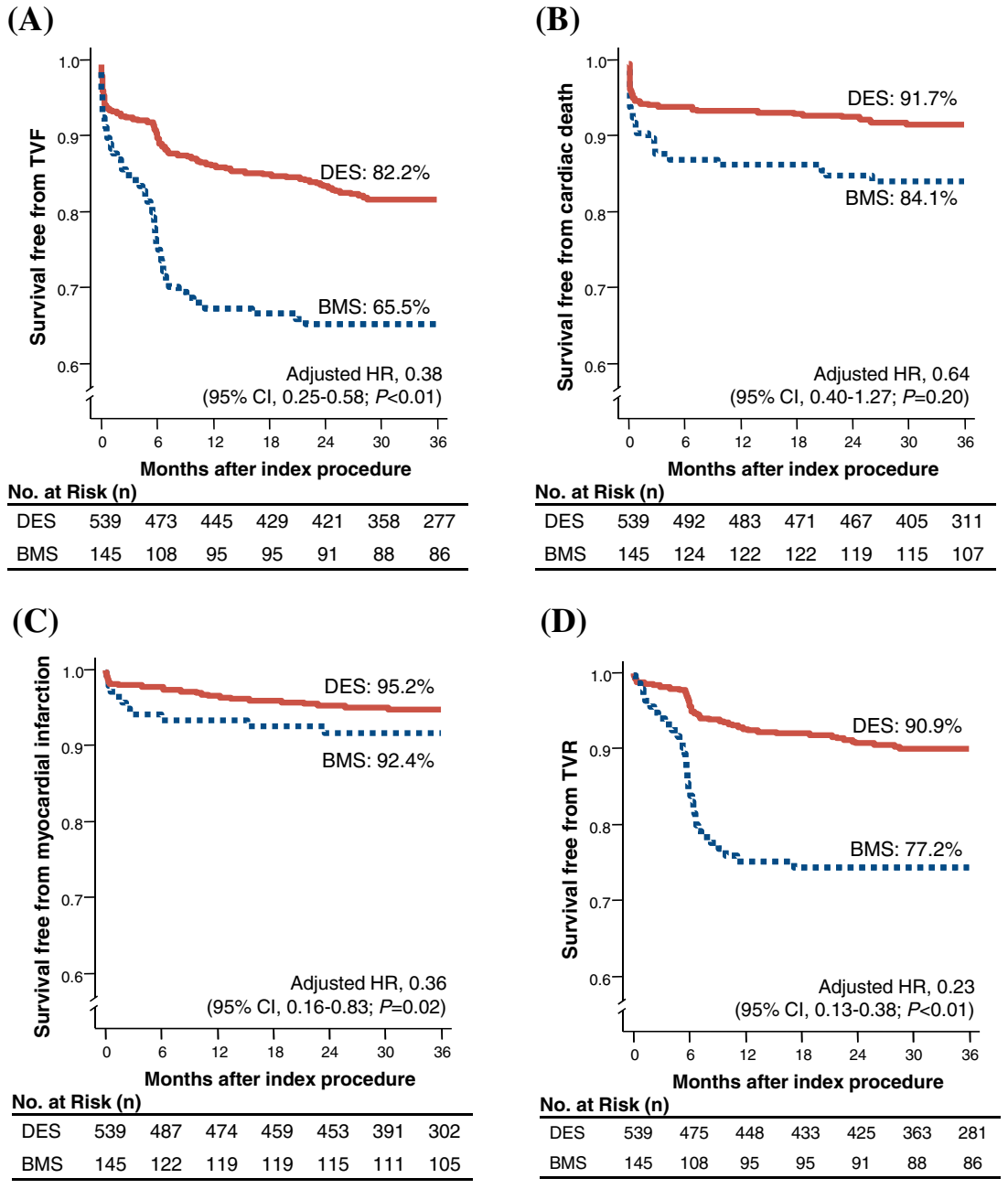


**Figure 2.** Event-free survival curves for (**A**) target vessel failure (TVF; a composite of cardiac death, non-fatal myocardial infarction, or target vessel revascularization (TVR)), (**B**) cardiac death, (**C**) non-fatal myocardial infarction, and (**D**) TVR. Hazard ratios (HR) and P-values were derived from multivariable adjustments with the use of a Cox proportional hazard model. DES, drug-eluting stents; BMS, bare metal stents.

## Clinical Outcomes

The cumulative outcomes of the crude study patients at 1 month, 6 months, 1 year, 2 years, and 3 years are shown in Table S4. After a median follow up of 36.0 months (interquartile range: 28.9–36.0 months), the event rate of TVF, defined as a composite of cardiac death, non-fatal MI and TVR, was significantly lower in the DES group compared with the BMS group [Figure 2A, adjusted hazard ratio (HR) 0.38, 95% confidence interval (CI) 0.25–0.58, P<0.01]. The benefit of DES was mainly driven by a significant reduction in TVR rate (Figure 2D, adjusted HR 0.23, 95%CI 0.13–0.38, P<0.01). While the event rate of non-fatal MI (Figure 2C) was significantly lower in the DES group, there was only an insignificant trend favoring DES with respect to cardiac death (Figure 2B).

In multivariate analysis using the stepwise forward Cox proportional hazard models, major independent predictors for TVF were as follows: the type of stent, cardiogenic shock

**Table 2. Incidence of ST**

| | DES (n=539) | BMS (n=145) | Unadjusted HR (95%CI) | P value |
|---|---|---|---|---|
| Acute ST (at ≤1 day) | 4 (0.7) | 1 (0.7) | 1.08 (0.12–9.71) | 0.95 |
| Subacute ST (within 2–30 days) | 14 (2.6) | 4 (2.8) | 0.94 (0.31–2.90) | 0.91 |
| Late ST (within 31–365 days) | 2 (0.4) | 1 (0.7) | 0.54 (0.05–5.96) | 0.61 |
| Very late ST (over 365 days) | 1 (0.2) | 0 (0.0) | – | 1.00 |
| Overall | 21 (3.9) | 6 (4.1) | 0.62 (0.17–2.30) | 0.47 |

ST, stent thrombosis; HR, hazard ratios; CI, confidence interval. Other abbreviations see in Table 1.

**Table 3. Risk of Adverse Events According to the DAT**

| | DAT<6 months | DAT≥6 months | DAT<12 months | DAT≥12 months | Adjusted HR (95%CI) | P value |
|---|---|---|---|---|---|---|
| **DES group** | | | | | | |
| n=481 | 21 | 460 | | | | |
| Death from any cause | 7 (33.3) | 20 (4.3) | | | 6.28 (1.83–21.54) | <0.01 |
| Cardiac death | 5 (23.8) | 7 (1.5) | | | 18.6 (4.70–73.74) | <0.01 |
| Non-fatal MI | 0 (0.0) | 15 (3.3) | | | – | 0.99 |
| Cardiac death+MI | 5 (23.8) | 20 (4.3) | | | 9.39 (2.64–33.37) | <0.01 |
| **DES group** | | | | | | |
| n=428 | | | 195 | 233 | | |
| Death from any cause | | | 9 (4.6) | 8 (3.4) | 0.64 (0.17–2.34) | 0.50 |
| Cardiac death | | | 3 (1.5) | 2 (0.9) | 1.51 (0.17–13.51) | 0.71 |
| Nonfatal MI | | | 7 (3.6) | 5 (2.1) | 3.13 (0.83–11.87) | 0.09 |
| Cardiac death+MI | | | 10 (5.1) | 7 (3.0) | 2.42 (0.81–7.19) | 0.11 |

HR and P values were derived from multivariable adjustments with the use of Cox proportional hazard model. MI, myocardial infarction. Other abbreviations see in Tables 1,2.

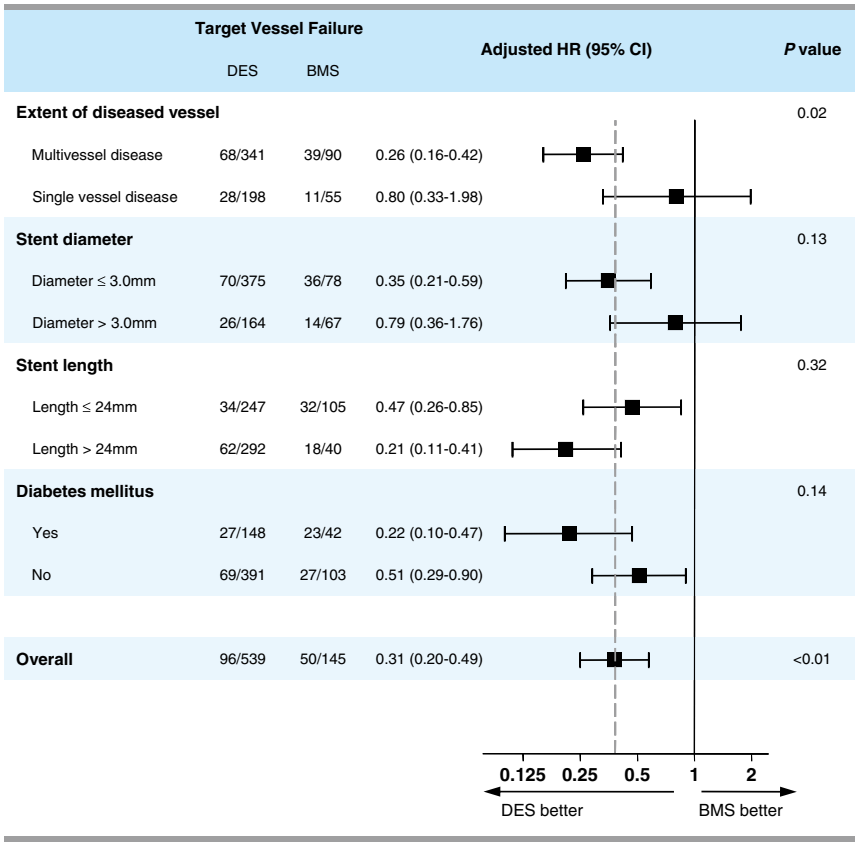


**Figure 3.** Subgroup analysis of target vessel failure in patients treated with drug-eluting stents (DES) or bare metal stents (BMS). Hazard ratios (HR) and P-values were derived from multivariable adjustments with the use of a Cox proportional hazard model. CI, confidence interval.

**Table 4. Baseline Characteristics of the Propensity-Score Matched Patients**

| Characteristics | DES (n=111) | BMS (n=111) |
|---|---|---|
| **Demographic characteristics** | | |
| Male sex, no (%) | 86 (77.5) | 86 (77.5) |
| Age, year | 62.4±12.3 | 62.3±12.9 |
| Hypertension, no (%) | 60 (54.1) | 61 (55.0) |
| Diabetes mellitus, no (%) | 42 (37.8) | 33 (29.7) |
| Smoking, no (%) | 42 (37.8) | 46 (41.4) |
| Dyslipidemia, no (%) | 24 (21.6) | 26 (23.4) |
| Chronic kidney disease, no (%) | 10 (9.0) | 7 (6.3) |
| Pain-to-balloon time, h* | 5.2 (2.8–10.6) | 5.1 (3.3–8.8) |
| Cardiogenic shock at admission, no (%) | 26 (23.4) | 20 (18.0) |
| Clinical indications, no (%) | | |
| Emergency PCI | 80 (72.1) | 79 (71.2) |
| Rescue PCI | 2 (1.8) | 2 (1.8) |
| Elective PCI | 29 (26.1) | 30 (27.0) |
| Ejection fraction, % | 46±13 | 48±12 |
| Follow-up duration, months | 30.0±10.6 | 61.4±10.9 |
| **Angiographic & Procedural characteristics** | | |
| Infarct-related vessel, no (%) | | |
| Left anterior descending coronary artery | 64 (57.7) | 58 (52.3) |
| Left circumflex coronary artery | 7 (6.3) | 8 (7.2) |
| Right coronary artery | 40 (36.0) | 45 (40.5) |
| Number of disease vessels, no (%) | | |
| Single vessel disease | 43 (38.7) | 47 (42.3) |
| 2 vessel disease | 43 (38.7) | 38 (34.2) |
| 3 vessel disease | 25 (22.5) | 26 (23.4) |
| Maximal stent diameter, mm | 3.2±0.4 | 3.2±0.6 |
| Total stented length, mm | 24.8±7.5 | 24.7±8.4 |

*Time intervals are compared only for the cases of primary procedure.
Abbreviations see in Table 1.

at admission (HR 3.19), advanced age (HR 1.02 per age), long stent length (HR 1.72), multivessel disease (HR 1.69), $\beta$-blocker use (HR 0.60) and statin use (HR 0.52).

With regard to the type of DES, both SES (adjusted HR 038, 95%CI 0.24–0.60) and PES (adjusted HR 0.36, 95%CI 0.19–0.68) showed significantly lower rates of TVF compared with BMS. The TVF rate was slightly lower in patients receiving SES compared with PES (17.4% vs 21.1%); however, this was not statistically significant (adjusted HR 0.89, 95%CI 0.51–1.55).

## ST

The overall incidence of definite and probable ST was similar between the DES group and the BMS group (3.9% vs 4.1%; P=0.47) (Table 2). The rate of definite ST also did not differ between the 2 groups (2.0% vs 2.1%; P=0.95). When dissected according to the timing of ST, the rates of acute, subacute and late ST were almost identical between the 2 groups. However, very late ST occurred in 1 case of DES group at 1.8 years. Actually, beyond the prespecified maximum follow-up duration of 3 years, there were 2 more very late ST cases at 3.2 years and 3.9 years, which were exclusively in the DES group. All of the 3 cases of very late ST had received SES, had been treated with DAT for at least 12 months, and were off clopidogrel but on aspirin at the time of ST occurrence.

## Duration of DAT

Whereas the duration of DAT was comparable between the 2 groups (P=0.99), the proportion of patients who had been treated with DAT for more than 6 months was greater in the DES group (95.6% vs 76.1%; P<0.01).

Cumulative incidence of death or non-fatal MI was analyzed with regard to the duration of DAT in the DES group. Premature interruption of DAT within the initial 6 months was a strong predictor of hard endpoints (HR 6.28, 95%CI 1.83–21.54, P<0.01). When the patients were divided again into 2 groups according to the duration of DAT within or more than 12 months, there was a trend favoring prolonged DAT over 12 months (HR 2.42, 95%CI 0.81–7.19, P=0.11), which was not statistically significant (Table 3).

## Subgroup Analysis

HRs with respect to TVF in several subgroups are illustrated in Figure 3. Patients with multivessel disease benefited from DES more than those with single vessel disease because there was a significant interaction with the treatment effect of DES (P=0.02). In addition, the benefit of DES was more prominent in diabetic patients and those who received stents small in diameter (≤3.0 mm) and long in length (≤24 mm). In turn, the treatment effect was neutral between DES and BMS for those with single vessel disease and those requiring implantation of large diameter stents.

## Characteristics and Outcomes of Patients Matched for Propensity Scores

In order to minimize selection bias of this retrospective study,

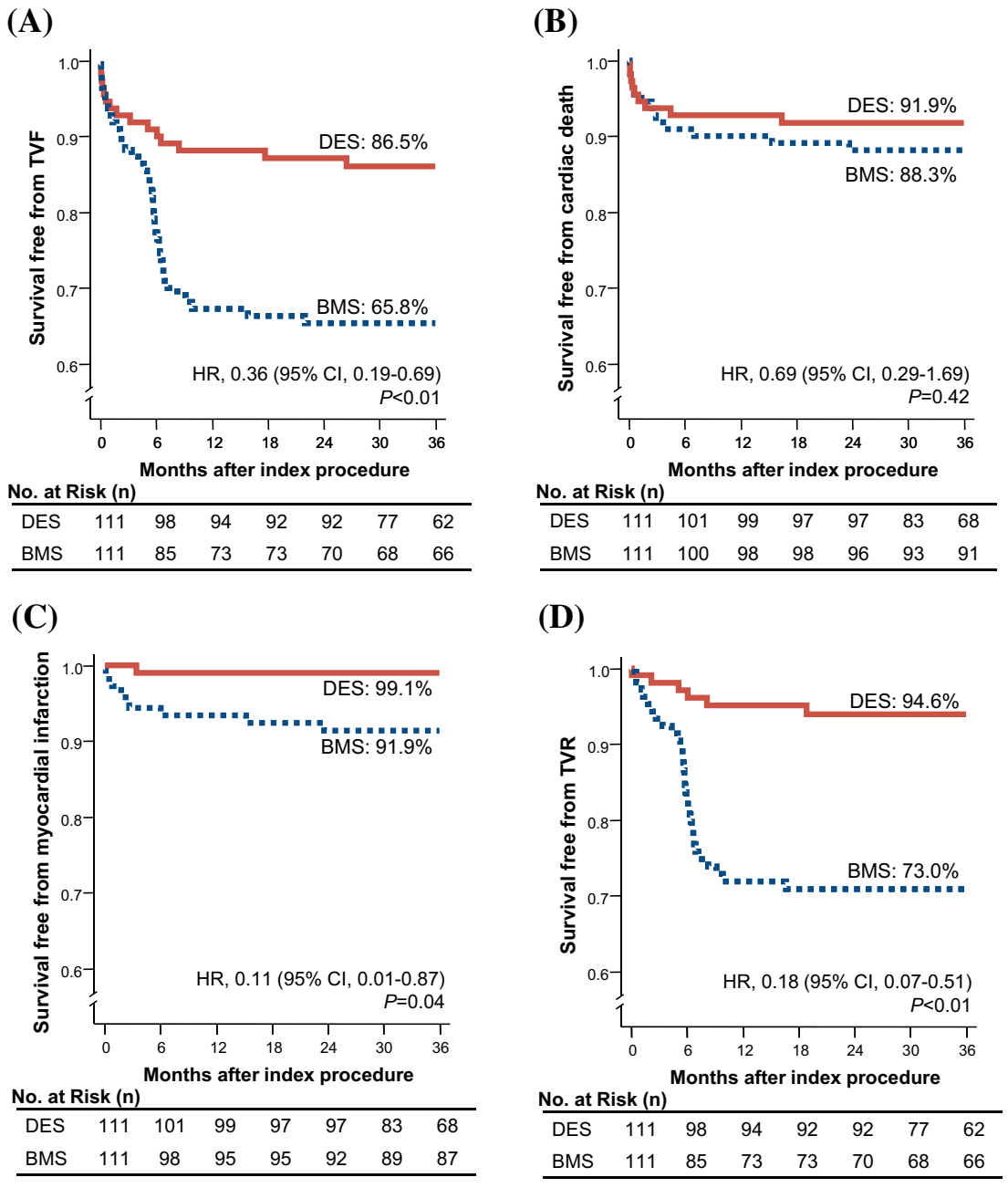


**Figure 4.** Event-free survival curves in the propensity-score matched cohorts for (**A**) target vessel failure (TVF), (**B**) cardiac death, (**C**) non-fatal myocardial infarction, and (**D**) target vessel revascularization (TVR). Hazard ratios (HR) and P-values were derived with the use of Cox regression analysis under consideration of clustering effects of matched cohort. DES, drug-eluting stents; BMS, bare metal stents.

we performed propensity score matching. After calculating the propensity for the treatment with DES vs BMS on the basis of 15 covariates, a total of 111 pairs of patients were matched according to the propensity score in 1:1 manner. **Table 4** shows baseline characteristics of the matched patient cohort, none of which differ significantly between the 2 groups. The analysis of propensity-score matched patients concordantly corroborated the result of the crude study population (**Figure 4**). There was a significant reduction in TVF rates in the DES group compared with the BMS group (HR 0.36, 95%CI 0.19–0.69, P<0.01). Again, this benefit was mostly accounted for by the decrease in the incidence of TVR (HR 0.18, 95%CI 0.07–0.51, P<0.01). Whereas non-fatal MI was significantly reduced in patients receiving DES, the risk reduction of DES regarding cardiac death was not statistically significant (**Table S5**).

## Discussion

In this study comparing the mid- to long-term outcomes of DES and BMS with a follow-up duration of up to 3 years in unselected patients with STEMI from a 2-center registry, we found that DES significantly reduced the risk of TVF as compared with BMS, which was mainly driven by a decreased need for TVR. DES was shown to be superior in the total crude patient population, as well as in the propensity score-matched pairs. The benefit of DES was particularly marked in patients with multivessel disease, in those receiving stents ≤3.0 mm in diameter, and in diabetic subjects. ST rates were similar between DES and BMS groups, although 3 very late stent thromboses occurred exclusively in the DES group. While premature discontinuation of DAT within 6 months was a powerful predictor of hard endpoints, data was inconclusive about the benefit of a prolonged administration of DAT for over 12 months.

Primary PCI is considered as the standard treatment in the management of STEMI.[3,17] Although the DES penetration rate is high in elective PCI, there is controversy regarding the use of DES in the setting of thrombogenic milieu such as STEMI. Nakazawa et al recently showed substantially delayed healing of vessels at the culprit site in acute MI (AMI) patients using pathologic assessment, and suggested an increased risk of thrombotic complications in patients treated with DES for AMI.[18] Against such concerns, several randomized controlled prospective trials (STRATEGY, TYPHOON, SESAMI, MISSION, etc) have reported the efficacy and safety of DES compared with BMS.[9,11–14] In contrary to SES, a study using PES showed only a statistically insignificant trend towards a favor in DES.[10] In the recently published HORIZONS-AMI trial, which included approximately 3,000 patients, PES showed significantly reduced ischemic TLR, while ST rates were comparable between PES and BMS.[19]

The major pitfall of the randomized control trials (RCT) is that the results were driven from short- to mid-term observations. In our study, the study patients were followed up for up to 3 years. The findings that DES was superior to BMS with regard to TVF, and that the benefit of DES was mainly driven by decreased needs for TVR, are mostly in agreement with previous studies. However, it is interesting that the Massachusetts registry showed that DES was associated with significantly lower mortality.[20] The finding was similarly observed in our study, which showed statistically significant or marginally insignificant trends toward a lower incidence of mortality. For example, the rates of hard endpoint, that is, a composite of death from any cause or recurrent MI, are strikingly similar between our data (11.5% vs 18.6% for DES vs BMS) and the Massachusetts registry (15.5% vs 19.6%). In addition, this study showed a significantly lower rate of recurrent MI in the DES group in crude analysis as well as in propensity score-matched analysis. However, to the best of our knowledge, there is yet no proven mechanism by which DES would work to improve hard outcomes, especially in the short term, where curves from both registries started to diverge. The possibilities that patients receiving BMS are just sicker patients, that hidden bias still remain and confound the outcomes, and that they are the reason for the early divergence in hard endpoints between DES and BMS cannot be ruled out. For instance, there was no such early divergence in hard endpoints in the HORIZONS-AMI study, a large-scale open-label RCT.[19] Therefore, we need to be careful in interpreting such data and it needs to be confirmed in further large scale randomized trials.

The TVR rate of the BMS group in our study (17.9% at 1 year, and 18.6% at 2 years) is somewhat high, when compared to certain RCTs such as TYPHOON and SESAMI, which reported a 1-year TVR rate in the BMS arm of 13.4% and 13.1%, respectively,[9,11] and the Massachusetts registry, which reported a 2-year TVR rate of 13.9%.[20] However, the 2-year TVR rate in the STRATEGY trial was 24%, which is greater than that reported in the present study.[12] A Korean study showed data of approximately 11.5% for the TLR rate at 6 months, which is quite similar to that of ours.[21] We do acknowledge that: (1) the routine follow-up angiography (over 70%); and (2) the high-risk feature of the study population in the present study might have resulted in raising the TVR rate. The characteristics of the patients in the present study showed that they were at a higher risk than patients of other RCTs: multivessel disease in 63.0% (compared with 47.2% in TYPHOON, 44.9% in PASSION, and 46.9% in SESAMI),[9–11] diabetes mellitus (DM) in 27.8% (compared with 16.3% in TYPHOON, 11.0% in PASSION , and 15.9% in HORIZONS-AMI),[9,10,19] Killip class ≥2 in 27.6% (compared with 8.6% in HORIZONS-AMI),[19] and cardiogenic shock in 18.3%. The relatively high incidences of multivessel disease and DM probably contributed significantly to raising the rate of TVR in the present study. Although a high rate for follow-up angiography might increase the absolute rate of repeat revascularization due to an 'oculostenotic reflex', it does not affect the relative difference in outcome of the 2 types of stents.

AMI is a well-known risk factor for ST. In the present study, the total ST rate at final follow up was similar between DES and BMS. Approximately 4% incidence of early and late ST in this study is similar to that of the TYPHOON trial (3.5% at 1 year),[9] and the HORIZONS-AMI (3.1% and 3.4% at 1 year).[19] In the Massachusetts registry, the largest and the longest data to date, the incidence of ST was not presented.[20] Korean multicenter registry data also showed similar rates of ST.[22,23] The ST data warrant a couple of discussion points. First, our data again shows the high rates of ST in the AMI setting, a factor which has been shown to be an independent predictor of ST after PCI.[24,25] There is definitely room for improvement regarding prevention of ST in AMI, and novel pharmacologic agents might help improve the results. Second, the steady occurrence of late ST at a rate of 0.4% to 0.7% is compatible with the observations from previous reports.[24–26] However, we believe that the ARC definition could overestimate the incidence of ST in the clinical settings of STEMI. A substantial proportion of "unexplained death" after STEMI might include mortalities from ventricular fibrillation, mechanical complications of MI, and so on. It is very difficult to differentiate whether patients died from ST or other complications of MI. Of note, we observed 3 cases of very late ST, which occurred exclusively in the DES group. Although the difference was statistically insignificant, we cannot make any solid conclusions that DES is identical to BMS with regard to long-term safety from this study.

Subgroup analysis suggested possibilities that certain groups could benefit more from DES, and that the use of stents might need to be stratified. We acknowledge that such data are just for hypothesis-generating at best, because the numbers were very modest. In the present study, DES showed greater benefits in those patients with multivessel disease, DM, and who received stents ≤3.0 mm in diameter. In contrast, because treatment effect was rather neutral in patients with single vessel disease and those receiving stents >3.0 mm in diameter, BMS could be suggested as a rational initial option in non-

DM patients with single vessel disease and a relatively large coronary artery. This finding is consistent with the results of the recently released HORIZONS-AMI trial, in which multivariable analysis identified 5 important predictors of 1-year TLR, including long lesion length, small vessel diameter, and DM, suggesting that BMS might act as effectively as DES in low-risk lesions for restenosis.[19]

Analysis regarding the adequate duration of DAT in the DES group demonstrated that DAT should be maintained without interruption for at least 6 months without any doubt. Although there was no significant benefit in prolonged use of DAT over 12 months, there still existed a trend for benefit in the longer duration group. We believe that these data need to be interpreted cautiously, because the duration of DAT was not randomly assigned, medication status was just based on patients' self-reporting, and the study was not powered in any way to make conclusions regarding this issue. There is also the very likely chance of confounding due to the preference of physicians to prescribe DAT over prolonged periods for high-risk patients.

There are several limitations in this study. First, the major limitation is that this was a retrospective analysis of a registry and that the patients were not randomly assigned to BMS vs DES groups. Our results are subject to selection bias and confounding with respect to the angiographic characteristics and patient compliance. One of the most important considerations in the use of BMS is the patient's compliance, which means that BMS are prone to be implanted in the patients who are expected not to be adherent to DAT. Moreover, it is likely that such patients are more complicated with co-morbidities. Second, another downside of the present study was the chronological difference in the use of DES and BMS; BMS was mostly used early in the study period, and DES in the later period. During the several years of enrollment duration, there have been profound changes in clinical practice. The differences we observed might reflect not only a better efficacy of DES, but also increased experience of the operator, improved catheterization techniques and imaging modalities, and more optimal medical management. As an example, there was a significant increase in the use of statins with time (57.7% in 2003, 61.7% in 2004, 66.5% in 2005, and 71.9% in 2006); and this is reflected in the difference in rates of discharge medication of statins between the 2 groups (68.8% vs 51.0%). Although we performed multivariable analyses and adopted propensity-score matching to minimize these biases, hidden bias might still remain due to the influence of unmeasured confounders. A final caveat is that no prior sample size has been calculated, and the number of patients analyzed in the present analyses was modest.

In conclusion, we report a mid- to long-term outcome of DES vs BMS in a retrospective, 2-center registry analysis, which showed significant benefit of DES in reducing the risk of TVF as compared with BMS in unselected patients with STEMI.

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## Disclosure

Conflict of Interest: none declared.

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## Supplementary files

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Please find supplementary file(s);
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