Coronary Artery Bypass Graft Surgery Versus Percutaneous Coronary Intervention With First-Generation Drug-Eluting Stents

A Meta-Analysis of Randomized Controlled Trials

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Objectives This study sought to compare the efficacy of coronary artery bypass graft surgery (CABG) to that of percutaneous coronary intervention (PCI) with first-generation drug-eluting stents among patients with multivessel disease (MVD), unprotected left main (LM) disease, and single-vessel proximal left anterior descending (LAD) disease.

Background The efficacy and safety of CABG versus PCI with drug-eluting stents in patient subgroups remains controversial.

Methods We systematically searched Cardiosource, Circulation, Clinicaltrials.gov, the Cochrane Library, EMBASE, and Medline for articles published through June 2013 for randomized controlled trials comparing CABG with PCI. Primary endpoints included mortality, myocardial infarction, revascularization, and stroke. Data were meta-analyzed with random-effects models.

Results We identified 7 randomized controlled trials (N = 5,835): 2 of MVD (n = 2,410, 100% diabetic), 2 of LM disease (n = 1,206, 29.0% diabetic), 1 of 3-vessel or LM disease (n = 1,900, 25.5% diabetic), and 2 of single-vessel proximal LAD disease (n = 319, 36.3% diabetic). In MVD patients, CABG reduced the risk of mortality (risk ratio [RR]: 0.70, 95% confidence interval [CI]: 0.57 to 0.87), myocardial infarction (RR: 0.47, 95% CI: 0.36 to 0.61), and repeat revascularization (RR: 0.36, 95% CI: 0.24 to 0.52), but increased stroke risk (RR: 1.72, 95% CI: 1.02 to 2.90). In patients with LM disease, CABG reduced revascularization risk (RR: 0.60, 95% CI: 0.46 to 0.78) and increased stroke risk (RR: 2.89, 95% CI: 1.15 to 7.27). Data for patients with single-vessel proximal LAD disease were inconclusive.

Conclusions CABG is more efficacious than is PCI with first-generation drug-eluting stents in patients with LM and MVD, at the cost of increased rates of stroke. No conclusion can be drawn for patients with single-vessel proximal LAD disease. (J Am Coll Cardiol Intv 2014;7:497–506) © 2014 by the American College of Cardiology Foundation

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The efficacy and safety of coronary artery bypass graft surgery (CABG) versus percutaneous coronary intervention (PCI) with first-generation drug-eluting stents (DES) remains controversial for the treatment of various patient subgroups.

Although this topic has been researched in many observational studies (1–5), the recommended procedural choice for patients within subgroups of vessel disease remains unclear due to a lack of data from randomized controlled trials (RCTs). Therefore, our objective was to conduct a meta-analysis of RCTs comparing the efficacy and safety of CABG to that of PCI with first-generation DES among patients with multivessel disease (MVD), unprotected left main (LM) disease, and single-vessel proximal left anterior descending artery (LAD) disease.

**Methods**

**Search strategy.** We systematically searched the Cochrane Library, EMBASE, and Medline for articles published through June 2013, with the terms “coronary angiography” and “coronary artery bypass surgery” and “coronary artery bypass graft” and “drug-eluting stents”. The search was restricted to RCTs conducted in humans and published in English. In addition, we searched Cardiosource, Circulation, and Clinicaltrials.gov, and we hand-searched the bibliographies of previous studies, relevant reviews, and previous meta-analyses to identify additional studies not found by our initial search. We conducted and reported our meta-analysis according to guidelines described in the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) (6) statement.

**Study selection.** We restricted inclusion to RCTs that compared the efficacy and safety of CABG to that of PCI with first-generation DES, as well as reported outcomes of mortality, myocardial infarction (MI), revascularization, or stroke. In addition, we only included trials in which the majority of patients who underwent PCI received DES. All studies not published in English were excluded.

**Data extraction.** Data extraction was performed by 2 reviewers, with disagreements resolved by consensus or by a third reviewer. Extracted data included study design, enrollment period, duration of follow-up, vessel subtypes (MVD, LM disease, proximal LAD disease), and the number of patients assigned to each group. Baseline participant characteristics included age, sex, body mass index, type 2 diabetes mellitus, systemic hypertension, dyslipidemia, previous MI, mean ejection fraction, and smoking. Extracted outcomes of interest were all-cause mortality, MI, revascularization, and stroke. Outcome data were extracted as count data following an intention-to-treat approach at the maximum available follow-up for all trials but FREEDOM (Future Revascularization Evaluation in Patients With Diabetes Mellitus: Optimal Management of Multivessel Disease), where 5-year results were extracted.

**Quality assessment.** We used the Cochrane Collaboration tool for assessing risk of bias to determine the quality of included RCTs (7). This tool assesses the risk of selection bias, performance bias, detection bias, attrition bias, reporting bias, and other bias. Each RCT is categorized on the basis of criteria determining the likelihood of potential threats to validity. Quality assessment was independently performed by 2 reviewers.

**Data analysis.** We used DerSimonian-Laird random-effects meta-analysis models with inverse variance weighting to calculate relative risks and corresponding 95% confidence intervals (CIs). In our primary analyses, we restricted inclusion to trials in which all patients in the PCI group received DES. In sensitivity analyses, we included RCTs in which the majority of patients received DES rather than bare-metal stents. The amount of heterogeneity present was estimated using the I² statistic. To examine potential sources of heterogeneity, we stratified our analyses by the following 3 types of coronary disease: MVD, LM disease, and proximal LAD disease. We visually inspected funnel plots and used the Egger test to assess publication bias. All analyses were conducted using Stata (version 11.2, Stata Corp., College Station, Texas).

**Results**

**Search results.** A total of 6,431 potentially relevant studies were identified in our initial literature search (Fig. 1). After screening the titles and abstracts of these studies, the full-length texts of 68 potentially relevant publications were retrieved and assessed for eligibility. Of these, 7 studies met our inclusion criteria and were included in our meta-analysis. No additional studies were identified through our manual search of references of published studies, relevant reviews, and previous meta-analyses.

**Study characteristics.** The earliest RCT we identified comparing CABG with PCI with first-generation DES was published in 2005. Included studies had sample sizes ranging from 130 to 1,900 patients and had follow-up durations ranging from 6 to 60 months (Table 1). Three RCTs (8–10) and a subgroup analysis (11) from the SYNTAX (Synergy
Between Percutaneous Coronary Intervention With Taxus and Cardiac Surgery) trial compared CABG with PCI with DES in patients with MVD \( (n = 4,210) \). Of note, the MVD subgroup of the SYNTAX trial included only patients with 3-vessel disease. Two RCTs \((12,13)\) and another subgroup \((14)\) of patients from SYNTAX examined patients with LM disease \( (n = 801) \). Two RCTs \((15,16)\) examined patients with single-vessel proximal LAD disease \( (n = 319) \). All included RCTs had a low risk of bias according to the Cochrane criteria (Online Appendix 1).

**Procedure characteristics.** Included RCTs varied with respect to the chosen surgical revascularization technique (Table 1). Both trials in patients with LM disease \((12,13)\) and 1 trial of patients with MVD \((8)\) employed standard CABG, whereas trials of patients with proximal LAD disease \((15,16)\) employed minimally invasive direct coronary artery bypass graft surgery (MIDCAB). The 2 remaining trials \((9,10)\) of patients with MVD selected the surgical revascularization technique according to surgeons’ recommendations.

All stents employed in the included trials were first-generation DES, including sirolimus-eluting stents (SES) and paclitaxel-eluting stents (PES). Bare-metal stents were used in a very small minority of patients with MVD \( (n = 31) \).

**Patient characteristics.** Baseline patient characteristics were well balanced across treatment groups. Most patients were middle-aged men, one-quarter of whom were current smokers (Online Appendix 2). Mean ejection fraction ranged from 52.5% to 66.5%. Approximately two-thirds of patients had hypertension, and two-thirds were hyperlipidemic. Among patients in both PCI and CABG groups, about one-fifth had experienced a previous MI.

Trials of patients with MVD were predominantly \((76.7\%)\) composed of patients with diabetes; 2 of the 3 largest RCTs included in our meta-analysis, CARDia (Coronary Artery Revascularization in Diabetes) \((8)\) and FREEDOM \((10)\), both included an exclusively diabetic patient population (Online Appendix 2). Slightly over one-quarter of patients in the SYNTAX trial had diabetes. Diabetes was present in 29% of patients with LM disease and 36.3% of patients with single-vessel proximal LAD disease.

**Overall meta-analysis results.** Overall, when data were pooled across subgroups, CABG was superior relative to PCI for mortality (Fig. 2) and MI (Fig. 3). However, CABG, compared with PCI, resulted in increased rates of stroke. Heterogeneity may be explained by vessel disease subgroup, and these overall results were driven by the strength of beneficial effect of CABG in patients with MVD (Table 2).

**Meta-analysis of patient subgroups.** Patients with MVD had a significantly reduced risk of all outcomes with CABG compared with those for PCI with DES, with the exception of stroke, which was increased (Fig. 4). Specifically, patients with MVD who underwent CABG had a lower risk of mortality (Fig. 2), MI (Fig. 3), and revascularization (Fig. 5). There was no significant difference between CABG and PCI with DES in patients with LM disease for mortality (Fig. 2) or MI (Fig. 3). However, patients with LM disease had a lower risk of repeat revascularization (Fig. 5) and a greater risk of stroke (Fig. 4) when undergoing CABG.

Treatment effect estimates for patients with single-vessel LAD disease were accompanied by very wide CIs. Consequently, no significant difference was found between procedures for all outcomes.
### Table 1. Characteristics of RCTs Comparing CABG to PCI with DES in Patients With MVD, LM Disease, and Proximal LAD Disease

<table>
<thead>
<tr>
<th>Study, Year (Ref. #)</th>
<th>Country</th>
<th>PCI (n)</th>
<th>CABG (n)</th>
<th>DES (%)</th>
<th>PES (%)</th>
<th>SES (%)</th>
<th>BMS (%)</th>
<th>Type of Surgery</th>
<th>IMA (%)</th>
<th>Inclusion</th>
<th>Exclusion</th>
<th>Follow-Up (Months)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MVD</td>
<td>FREEDOM, 2012 (10)</td>
<td>INT</td>
<td>953</td>
<td>947</td>
<td>100</td>
<td>43</td>
<td>51</td>
<td>0</td>
<td>Surgeons’ choice (unspecified % MIDCAB)</td>
<td>0</td>
<td>DM, MVD, eligible for both PCI and CABG</td>
<td>Severe CHF, previous cardiac surgery, ACS</td>
</tr>
<tr>
<td></td>
<td>CARDia, 2010 (8)</td>
<td>UK</td>
<td>256</td>
<td>254</td>
<td>69</td>
<td>0</td>
<td>69</td>
<td>31</td>
<td>Standard CABG</td>
<td>94</td>
<td>DM, MVD, complex SVD</td>
<td>ACS, LM previous intervention</td>
</tr>
<tr>
<td>LM Disease</td>
<td>PRECOMBAT, 2011 (13)</td>
<td>Korea</td>
<td>300</td>
<td>300</td>
<td>100</td>
<td>0</td>
<td>100</td>
<td>0</td>
<td>Standard CABG</td>
<td>0</td>
<td>LM</td>
<td>ACS, previous intervention, EF &lt;30%</td>
</tr>
<tr>
<td></td>
<td>Boudriot, 2011 (12)</td>
<td>Germany</td>
<td>100</td>
<td>101</td>
<td>100</td>
<td>2</td>
<td>98</td>
<td>0</td>
<td>Standard CABG</td>
<td>50</td>
<td>LM</td>
<td>ACS, previous surgical intervention, severe PVD</td>
</tr>
<tr>
<td>3-Vessel or LM Disease*</td>
<td>SYNTAX, 2009 (9)</td>
<td>USA, Europe</td>
<td>903</td>
<td>897</td>
<td>100</td>
<td>100</td>
<td>0</td>
<td>0</td>
<td>Surgeons’ choice (15% MIDCAB)</td>
<td>0</td>
<td>MVD and/or LM</td>
<td>Previous intervention, acute MI</td>
</tr>
<tr>
<td>Proximal LAD Artery Disease</td>
<td>Hong, 2005 (16)</td>
<td>Korea</td>
<td>119</td>
<td>70</td>
<td>100</td>
<td>20</td>
<td>80</td>
<td>0</td>
<td>MIDCAB</td>
<td>37</td>
<td>Isolated LAD stenosis</td>
<td>ACS, previous intervention</td>
</tr>
<tr>
<td></td>
<td>Thiele, 2009 (15)</td>
<td>Germany</td>
<td>65</td>
<td>65</td>
<td>100</td>
<td>0</td>
<td>100</td>
<td>0</td>
<td>MIDCAB</td>
<td>50</td>
<td>Isolated LAD stenosis</td>
<td>ACS, previous intervention</td>
</tr>
</tbody>
</table>

*SYNTAX included patients with 3-vessel or LM disease. Secondary analyses were conducted in which patients were stratified by type of underlying coronary disease. Where possible, we present the results of these subgroup analyses in the current meta-analysis, which were reported at the end of follow-up (48 months).

ACS = acute coronary syndrome; BMS = bare-metal stent; CABG = coronary artery bypass graft surgery; CARDia = Coronary Artery Revascularization in Diabetes; CHF = congestive heart failure; DES = drug-eluting stent; DM = diabetes mellitus; EF = ejection fraction; FREEDOM = Future Revascularization Evaluation in Patients With Diabetes Mellitus: Optimal Management of Multivessel Disease; IMA = internal mammary artery; INT = international; LAD = left anterior descending; LM = left main; MI = myocardial infarction; MIDCAB = minimally invasive direct coronary artery bypass graft surgery; MVD = multivessel disease; PCI = percutaneous coronary intervention; PES = paclitaxel-eluting stent; PRECOMBAT = Premier of Randomized Comparison of Bypass Surgery Versus Angioplasty Using Sirolimus-Eluting Stent in Patients With Left Main Coronary Artery Disease; PVD = peripheral vascular disease; RCT = randomized controlled trial; SES = sirolimus-eluting stent; SVD = single-vessel disease; SYNTAX = Synergy Between Percutaneous Coronary Intervention With Taxus and Cardiac Surgery.
Visual inspection of the funnel plot (Online Appendix 3) and Egger test ($p = 0.025$) suggested the presence of publication bias.

**Discussion**

Our study was designed to compare the efficacy and safety of CABG with that of PCI with first-generation DES across subgroups of coronary artery vessel disease in terms of mortality, MI, revascularization, and stroke. Our results suggest that in patients with MVD, CABG reduces mortality, MI, and repeat revascularization, but increases the risk of stroke when compared with first-generation DES. In patients with LM disease, CABG was associated with a reduced risk of revascularization, with an increased risk of stroke, and no significant differences in death or MI. Available data were insufficient to draw meaningful conclusions regarding the relative efficacies of CABG and PCI with DES in patients with single-vessel proximal LAD disease.

As an important caveat, both the FREEDOM and CARDia trials were conducted in diabetic patients. Diabetes is a well-known risk factor for cardiovascular disease, and several studies have concluded that CABG is preferable to PCI in diabetics (17,18). Two of the 3 largest RCTs examining patients with MVD included an exclusively diabetic population; as a result, our findings showing a significant benefit of CABG versus DES in MVD may be driven by this effect. A recent study stratifying the results of the SYNTAX trial by diabetes status found that diabetic patients with 3-vessel disease had a marked clinical benefit with CABG versus PCI with DES (18). This benefit was also present among nondiabetic patients, albeit less pronounced. Among both diabetic and nondiabetic patients, the rates of all-cause death were similar with both CABG and PCI, whereas cardiac death occurred more frequently with PCI than with CABG (nondiabetic hazard ratio [HR]: 1.62, 95% CI: 1.03 to 2.55; diabetic HR: 2.01, 95% CI: 1.04 to 3.88). Both diabetic and nondiabetic patients...
experienced higher rates of repeat revascularization after PCI relative to CABG (diabetic HR: 2.75, 95% CI: 1.78 to 4.24, p < 0.001; nondiabetic HR: 1.82, 95% CI: 1.39 to 2.38). Nondiabetic patients had a higher rate of MI following PCI relative to CABG (HR: 2.90, 95% CI: 1.70 to 4.70), whereas no such difference was found among diabetic patients (HR: 1.62, 95% CI: 0.77 to 3.41). Neither diabetic nor nondiabetic patients had significantly different risks of stroke across CABG or PCI. Together, these results suggest that a protective effect conferred by CABG to patients with 3-vessel disease exists for both diabetic and nondiabetic individuals.

CABG may also be beneficial for patients with high disease complexity and severity. The 3-vessel disease patient subgroup in the SYNTAX trial also reported that patients with more severe disease (as determined by the SYNTAX score [19]) who received PCI had a significantly higher risk of mortality than did patients with high scores who received CABG. Similarly, a recent meta-analysis of observational and randomized studies found that, compared with patients

Table 2. Treatment Effects Obtained From the Meta-Analysis of RCTs Comparing CABG to PCI With DES Overall and in Patients With MVD, LM Disease, and Proximal LAD Disease*

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Mortality</th>
<th>MI</th>
<th>Revascularization</th>
<th>Stroke</th>
</tr>
</thead>
<tbody>
<tr>
<td>MVD</td>
<td>0.73 (0.56–0.96)</td>
<td>0.45 (0.34–0.60)</td>
<td>0.36 (0.26–0.51)</td>
<td>1.72 (1.02–2.90)</td>
</tr>
<tr>
<td>Unprotected LM disease</td>
<td>1.08 (0.75–1.57)</td>
<td>0.69 (0.41–1.16)</td>
<td>0.60 (0.46–0.78)</td>
<td>2.89 (1.15–7.27)</td>
</tr>
<tr>
<td>Single-vessel proximal LAD disease</td>
<td>2.34 (0.57–9.64)</td>
<td>1.85 (0.46–7.40)</td>
<td>0.55 (0.05–6.24)</td>
<td>5.07 (0.21–122.80)</td>
</tr>
<tr>
<td>Overall</td>
<td>0.85 (0.64–1.12)</td>
<td>0.58 (0.40–0.84)</td>
<td>0.51 (0.39–0.67)</td>
<td>1.79 (1.23–2.62)</td>
</tr>
</tbody>
</table>

Values are risk ratio (95% confidence interval). *Data were pooled across trials using random-effects meta-analytic models.

Abbreviations as in Table 1.
with low SYNTAX scores, those with high scores had significantly higher rates of major adverse cardiovascular and cerebrovascular events with PCI than with CABG at 12, 24, and 36 months of follow-up (20). That is, the benefits of CABG versus PCI differ across disease severity. Additional support is lent to this reasoning based on the recent release of the 5-year follow-up data from the SYNTAX trial: after 5 years, patients with severe disease (as indicated by a high SYNTAX score) had lower mortality rates among the CABG treatment group, relative to the PCI group (21). Among patients with a low or intermediate SYNTAX score, mortality rates were similar across both treatment groups. However, patients with an intermediate SYNTAX score had significantly higher rates of MI and repeat revascularization with PCI than with CABG. Overall, the 5-year SYNTAX results show that approximately two-thirds of patients with complex coronary disease derive greater benefit from CABG than from PCI with first-generation DES, whereas the remaining patients may derive comparable benefit from PCI. These findings support the use of CABG in patients with MVD, particularly among those with complex or severe disease. Evidence for the optimal treatment of LM disease is less clear. Results from our meta-analysis suggest a possible benefit favoring CABG, albeit statistically inconclusive. These inconclusive results may be due in part to the relatively smaller sample size of patients with LM disease. However, results from a large retrospective multinational registry comparing CABG and PCI with first-generation DES in patients with LM disease also showed no difference between procedures for death, MI, and cerebrovascular accidents at a median follow-up of 1,295 days (22). Our analyses show that in patients with LM disease, CABG results in a decreased risk of revascularization (Fig. 5) and an increased risk of stroke (Fig. 4). Increasingly, however, revascularization is not being considered as clinically significant as death, MI, or stroke (20,23). Thus, the evidence favoring CABG over PCI with first-generation DES for patients with LM disease is not as strong as for patients with MVD.

Our study had insufficient power to draw clinically directive conclusions for patients with single-vessel proximal LAD disease. There are only 2 trials in patients with proximal LAD disease, and these had a substantially shorter duration of follow-up relative to all other included RCTs. Although the evidence comparing CABG with PCI with first-generation DES is limited, a previous trial comparing PCI with bare-metal stents found that patients undergoing

![Figure 4. Forest Plot of RCTs Comparing the Effect of CABG on Stroke to That of PCI With DES](image-url)
PCI had a higher risk of major adverse cardiovascular events after 5 years (24). However, with the exception of a higher risk of repeat revascularization with PCI, the risk of death and MI was similar in both groups. Although these findings suggest PCI may be comparable to CABG in patients with proximal LAD disease, statistically inconclusive results highlight the need to rely on additional clinical considerations to aid in procedural choice.

Results from a recent study validating the SYNTAX score II (25), an enhanced version of the SYNTAX score with prognostically important clinical variables, confirmed the importance of considering clinical characteristics in weighing the benefits of CABG against those of PCI. The investigators demonstrated that the low, intermediate, and high anatomical complexity SYNTAX score categories incorrectly categorized lower-risk patients in high SYNTAX score groups and higher-risk patients in low SYNTAX score groups. To correct for this misclassification, the SYNTAX score II considered additional patient factors including age, creatinine clearance, left ventricular ejection fraction, sex, chronic obstructive pulmonary disease, and peripheral vascular disease. The presence of these clinical characteristics modified the threshold of the SYNTAX score at which 4-year mortality rates were similar between CABG and PCI. Among patients with LM disease who underwent PCI, higher anatomical SYNTAX scores were required to achieve similar long-term prognosis as for patients who received CABG. By contrast, among patients with 3-vessel disease, the SYNTAX score was representative of greater disease complexity than that for patients with LM disease with identical SYNTAX scores. Thus, patients with 3-vessel disease would have better long-term outcomes with CABG. These findings highlight the importance of considering all patient factors, particularly in the event where the choice of procedure is not straightforward.

There is suggestive evidence that first- and second-generation stents may have differential efficacy profiles, which in turn could affect the optimal procedural choice between CABG and PCI with DES. Results from the SPIRIT IV (Clinical Evaluation of the Xience V Everolimus Eluting Coronary Stent System IV) trial (26) revealed that, at 1 year after PCI, patients treated with everolimus-eluting stents (EES), compared with patients treated with PES, had a lower occurrence of MI (EES: 1.9%, PES: 3.1%, p = 0.02),
definite stent thrombosis (EES: 0.3%, PES: 1.1%, p = 0.004), target lesion revascularization (EES: 2.5%, PES: 4.6%, p = 0.001), target vessel revascularization (EES: 3.9%, PES: 5.9%, p = 0.009), and major adverse cardiovascular events (EES: 4.2%, PES: 6.9%, p = 0.001).

Similarly, 1-year post-PCI, results from the XAMI (Xience V Stent vs. Cypher Stent in Primary PCI for Acute Myocardial Infarction) trial (27) showed major adverse cardiovascular event rates were significantly lower among patients treated with EES relative to SES (RR: 0.52, 95% CI: 0.27-1.00, p = 0.048). Although there may be clinical differences attributable to stent type and generation, it remains unclear to what extent these affect the choice between second-generation DES and CABG.

**Study limitations.** First, the included RCTs varied in study design, patient characteristics, procedural differences, and duration of follow-up. To account for this between-study heterogeneity, we used random-effects models. We also stratified our analyses by type of coronary disease to explicitly examine the impact of this source of heterogeneity. Second, we found evidence of publication bias, which may have resulted in an overestimate of the protective effects of CABG. Although this may have affected our results for LM or proximal LAD patients, it is unlikely to have biased our MVD analyses as all trials in this patient subpopulation were large (i.e., >500 patients) and thus likely to be published regardless of statistical significance. Third, diabetic patients were over-represented in trials conducted in patients with MVD. In addition, CABG and PCI with DES were only compared in patients with single-vessel proximal LAD disease in 2 relatively small RCTs to date; analyses conducted in this subpopulation, therefore, had only modest statistical power. Despite the varying duration of follow-up across studies, the absence of reported event rates necessitated the calculation of pooled relative risks. Among patients with LAD disease, surgical outcomes referred solely to MIDCAB, limiting our ability to comment on the efficacy of standard CABG for LAD disease. Finally, only first-generation DES were employed in all included RCTs, limiting our ability to draw conclusions for second-generation devices.

**Conclusions**

We found that CABG has superior efficacy when compared to PCI with first-generation DES in patients with MVD but results in an increased risk of stroke. Among patients with LM disease, CABG reduces the risk of revascularization and increases the risk of stroke. Results were inconclusive in patients with single-vessel proximal LAD disease. Our observed treatment benefits in patients with MVD but not others is consistent with the need to consider risk profiles and disease complexity in selecting the optimal revascularization procedure.

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**REFERENCES**


15. Thiele H, Neumann-Schöndewind P, Jacobs S, et al. Randomized comparison of minimally invasive direct coronary artery bypass surgery...

Key Words: coronary artery bypass graft || drug-eluting stent(s) || meta-analysis.

APPENDIX

For supplemental information, please see the online version of this paper.