Drug-eluting stents Versus Coronary Artery Bypass Grafting in Multivessel Disease and Left Main Obstruction: Meta-analysis of Randomized Clinical Trials

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Abstract

Background: The choice between percutaneous coronary intervention (PCI) and coronary artery bypass grafting (CABG) remains controversial.

Objective: To conduct a meta-analysis of randomized studies comparing drug-eluting stents (DES) and CABG in multivessel disease or obstruction of the left main coronary artery.

Method: Electronic databases were searched systematically to evaluate results of randomized trials comparing PCI with DES versus CABG in multivessel disease and obstruction of the left main coronary artery. Ten studies were identified.

Results: In the aggregated results (n = 9268), mortality at 30 days and incidence of stroke favored PCI (0.8% versus 1.5%, p = 0.005; 0.4% versus 1.5%, p < 0.0001, respectively). There was no difference in mortality at 1 year (3.4% versus 3.5%, p = 0.50). The late mortality favored CABG (10.1% versus 8.5%, p = 0.01). In patients with diabetes derived from four studies (n = 3830), late mortality favored CABG (12.5% versus 9.7%, p < 0.0001). In six studies of left main coronary artery obstruction (n = 4700), the incidence of stroke favored PCI (0.3% versus 1.5%, p < 0.001) and there was no difference in mortality at 30 days (0.8% versus 1.3%, p = 0.15), mortality at 1 year, or late mortality (8.1% versus 8.1%). The subgroups with high SYNTAX score and diabetes were those influencing most strongly and adversely the PCI results.

Conclusion: When compared with PCI, CABG was superior in regards to late mortality and inferior in regards to 30-day mortality and incidence of stroke. Diabetes and SYNTAX score strongly impacted the results. (Int J Cardiovasc Sci. 2018;31(2)152-162)

Keywords: Myocardial Revascularization; Drug Eluting Stents; Randomized Controlled Trials as Topic; Meta-Analysis.
references of reviews published on the subject. The date of January 2002 was chosen as the initial period since drug-eluting stents began to be established as a therapeutic method after that. Clinical trials were included in the review if they were randomized, had compared surgery and coronary angioplasty, used drug-eluting stents, involved exclusively multivessel disease or left main coronary artery obstruction, had a minimum follow-up of 1 year, and were published in international journals with an impact factor > 2.0. We used the following terms in the search: coronary artery bypass surgery, coronary stents, and randomized controlled trials. Studies exclusively using balloon or bare-metal stents, or which assessed predominantly one-vessel disease were not included. Studies using drug-eluting and bare-metal stents\(^{2,4}\) were included as studies of the drug-eluting stent era. Works resulting from observational studies (registries) or only published as meetings proceedings were not considered.

We identified 10 randomized studies that satisfied the requirements: LE MANS,\(^{1}\) SYNTAX,\(^{2,3}\) CARDia,\(^{4}\) Boudriot et al.,\(^{5}\) PRECOMBAT,\(^{6}\) VA CARDS,\(^{7}\) FREEDOM,\(^{8}\) BEST,\(^{9}\) NOBLE,\(^{10}\) and EXCEL.\(^{11}\) Three authors (PJNA, BAAF, and JLAAF) evaluated the studies, which were all considered to be of high quality.

The main outcomes of interest were mortality and stroke. The incidence of AMI was not evaluated because the definition of this event varied widely in the studies. We also did not evaluate the incidence of new revascularization, because the superiority of surgery on this outcome is well established. Mortality was divided into early mortality, mortality at 1 year, and late mortality. Early mortality was defined as death occurring up to 30 days after the procedure, including deaths occurring after randomization but before the procedure. This mortality was obtained from seven studies, whereas three studies did not provide this information.\(^{2,4,7}\) Mortality at 1 year was defined as death occurring up to 1 year after the procedure, including early mortality. This mortality was obtained from nine studies, while one study did not provide such information.\(^{7}\) Late mortality was defined as death recorded at the end of follow-up, after at least 3 years. This mortality was obtained from eight studies, six of which performed a follow-up for 5 years, one for 3 years\(^{2}\) and one for 10 years.\(^{1}\) We were unable to obtain this information from two studies.\(^{2,7}\) For the incidence of stroke, we considered the events occurring up to 1 year after the procedure. In eight studies, we obtained the results up to 30 days and in one of them,\(^{2}\) up to 1 year, while in one of the studies, this information was unavailable.\(^{7}\) We evaluated separately the results of studies in the left main coronary artery and late mortality in the subgroup of patients with diabetes. We also performed analysis of combined major adverse cardiac and cerebrovascular events (MACCE) and assessed the variables age, gender, presence of diabetes, SYNTAX score, and compromised ejection fraction in subgroups based on data published in five trials.\(^{2,4,6,8,9}\) Combined MACCE comprised death, AMI, and new revascularization in two of these trials,\(^{6,9}\) and death, AMI, and stroke in the remaining ones.

In order to aggregate the outcomes of mortality and stroke, as well as those of MACCE (in subgroups), we considered whenever possible the absolute number of events and the number of patients followed up. Otherwise, percentages were transformed into absolute numbers.

### Statistical analysis

We measured the relative risk and the risk difference after grouping the results of each outcome. In order to assess the statistical significance of the differences between the drug-eluting stent and the surgery groups, we performed a meta-analysis using the Mantel-Haenszel method, with a fixed-effect model. We calculated the heterogeneity of the studies using Cochran’s Q test and the significance of the measure of the meta-analytic effect using the Z test. The differences between the results in the stent and CABG groups were considered significant if p < 0.05.

The statistical analyses were performed using the program Review Manager (RevMan), version 5.3 (Copenhagen: The Nordic Cochrane Centre, The Cochrane Collaboration, 2014).

In order to represent the heterogeneity of the studies, we constructed Forest plots. We used the risk difference to plot these graphs since this is a more stable index. We refrained from using odds ratio or relative risk due to the inclusion of some clinical trials with zero or near zero events.

### Results

**Characteristics of the trials are shown in table 1**

The studies included a total of 9268 patients (4642 in the stent group and 4626 in the CABG group). The mean age of the patients was 64 years, 75% were male, 51% were diabetic, 24% were smokers, 64% were hypertensive, and 31% had unstable angina. The mean ejection fraction (reported in seven studies) was 59%, the mean EuroSCORE (reported in five studies) was 2.9, and the mean SYNTAX
showed low heterogeneity ($I^2 = 0$) and favored the stent group (0.8% versus 1.5%, $p = 0.005$). As for mortality up to 1 year, the studies presented low heterogeneity ($I^2 = 0$%) and no difference between the groups (3.4% versus 3.5%, $p = 0.50$). In late mortality, the studies showed low heterogeneity ($I^2 = 0$%) and favored CABG (10.1% versus 8.5%, $p = 0.01$). After exclusion of patients with diabetes from four studies (SYNTAX, FREEDOM, BEST, and CARDIa), the differences in late mortality tended to disappear (8.5% versus 8.1%, $p = 0.6$).

In the six studies evaluating left main coronary artery obstruction (LE MANS, SYNTAX LEFT MAIN, PRECOMBAT, EXCEL, NOBLE, and the study by Boudriot et al.) totaling 4700 patients, there was no difference in mortality at 30 days (0.8% versus 1.4%, $p = 0.15$), 1 year (3.0% versus 3.7%, $p = 0.18$), or in late mortality (8.1% versus 8.1%). There was a significant difference in favor of the stent group in the incidence of stroke (0.3% versus 1.5%, $p < 0.0001$).

Four studies reported late mortality in patients with diabetes (SYNTAX, CARDIa, FREEDOM, and BEST). In the combined results ($n = 3223$), mortality up to 5 years was 12.5% in the stent group versus 9.7% in the surgery group ($p < 0.0001$).

Five studies provided the outcomes of the late incidence of combined adverse events (MACCE) divided into subgroups, which are represented in Figure 7. The combined MACCE outcomes in these subgroups (Figure 7) show that a SYNTAX

### Outcomes

The outcomes are summarized in Figures 1 to 6. The incidence of stroke up to 1 year had a low heterogeneity ($I^2 = 0$). The results favored PCI (0.4% versus 1.5%, $p < 0.00001$). In regards to 30-day mortality, the studies

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>Stent Events</th>
<th>Total</th>
<th>Stent Events</th>
<th>Total</th>
<th>Risk Difference M-H, Fixed, 95% CI</th>
<th>Risk Difference M-H, Fixed, 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>BEST 2015</td>
<td>3 438</td>
<td>7 442</td>
<td>3 438</td>
<td>7 442</td>
<td>-0.01 [-0.02, 0.00]</td>
<td>-0.01 [-0.02, 0.00]</td>
</tr>
<tr>
<td>Boudriot et al. 2011</td>
<td>0 100</td>
<td>0 101</td>
<td>0 100</td>
<td>0 101</td>
<td>-0.00 [-0.01, 0.01]</td>
<td>-0.00 [-0.01, 0.01]</td>
</tr>
<tr>
<td>EXCEL 2010</td>
<td>9 948</td>
<td>10 957</td>
<td>9 948</td>
<td>10 957</td>
<td>-0.00 [-0.02, 0.00]</td>
<td>-0.00 [-0.02, 0.00]</td>
</tr>
<tr>
<td>FREEDOM 2012</td>
<td>8 953</td>
<td>15 947</td>
<td>8 953</td>
<td>15 947</td>
<td>-0.04 [-0.10, 0.02]</td>
<td>-0.04 [-0.10, 0.02]</td>
</tr>
<tr>
<td>LE MANS 2008</td>
<td>0 52</td>
<td>2 53</td>
<td>0 52</td>
<td>2 53</td>
<td>-0.01 [-0.02, 0.00]</td>
<td>-0.01 [-0.02, 0.00]</td>
</tr>
<tr>
<td>NOBLE 2016</td>
<td>2 592</td>
<td>7 592</td>
<td>2 592</td>
<td>7 592</td>
<td>-0.01 [-0.02, 0.00]</td>
<td>-0.01 [-0.02, 0.00]</td>
</tr>
<tr>
<td>PRECOMBAT 2011</td>
<td>4 300</td>
<td>9 300</td>
<td>4 300</td>
<td>9 300</td>
<td>-0.02 [-0.04, 0.01]</td>
<td>-0.02 [-0.04, 0.01]</td>
</tr>
<tr>
<td>Subtotal (95 CI)</td>
<td>3383</td>
<td>3392</td>
<td>3383</td>
<td>3392</td>
<td>-0.01 [-0.02, 0.00]</td>
<td>-0.01 [-0.02, 0.00]</td>
</tr>
<tr>
<td>Total events</td>
<td>26</td>
<td>51</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Heterogeneity: $\chi^2 = 3.65$, df = 6 ($p = 0.72$); $I^2 = 0$

Test for overall effect: $Z = 2.83$ ($p < 0.005$)

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**Figure 1** - Mortality at 30 days: stent versus coronary artery bypass grafting.

The size of the squares is proportional to the number of patients. The bars represent 95% confidence intervals. The diamond represents the synthesis of the results.

Abbreviations: CABG: coronary artery bypass grafting; LE MANS: Left Main Coronary Artery Stenting; FREEDOM: Future Revascularization Evaluation in Patients with Diabetes Mellitus; BEST: Bypass Surgery and Everolimus-Eluting Stent Implantation in the Treatment of Patients with Multivessel Coronary Artery Disease; PRECOMBAT: Premier of Randomized Comparison of Bypass Surgery versus Angioplasty Using Sirolimus-Eluting Stent in Patients with Left Main Coronary Artery Disease; EXCEL: Coronary Artery Bypass Surgery for Effectiveness of Left Main Revascularization; NOBLE: Nordic-Baltic-British Left Main Revascularization; Boudriot: study by Boudriot et al.; J Am Coll Cardiol. 2011; 57: 538-545.

Graph obtained using the software Review Manager (RevMan), version 5.3.
score in the upper tertile and the occurrence of diabetes had a strong negative influence on the PCI outcome. In patients in the lower SYNTAX tertile and in those without diabetes, there was no significant difference in terms of MACCE between the CABG and PCI groups. The elderly condition and the female gender contributed to the difference in results but to a lesser degree. An ejection fraction < 50% did not contribute significantly to the difference in results.
Figure 4 – Stroke: stent versus coronary artery bypass grafting.

The size of the boxes is proportional to the number of patients. The bars represent 95% confidence intervals. The diamond represents the synthesis of the results. Abbreviations: CABG: coronary artery bypass grafting; SYNTAX: Synergy between PCI with Taxus and Cardiac Surgery; CARDia: Coronary Artery Revascularization in Diabetes; LE MANS: Left Main Coronary Artery Stenting; FREEDOM: Future Revascularization Evaluation in Patients with Diabetes Mellitus; VA CARDS: Coronary Artery Revascularization in Diabetes; BEST: Bypass Surgery and Everolimus-Eluting Stent Implantation in the Treatment of Patients with Multivessel Coronary Artery Disease; PRECOMBAT: Premier of Randomized Comparison of Bypass Surgery versus Angioplasty Using Sirolimus-Eluting Stent in Patients with Left Main Coronary Artery Disease; EXCEL: Coronary Artery Bypass Surgery for Effectiveness of Left Main Revascularization; NOBLE: Nordic-Baltic-British Left Main Revascularization Study; Boudriot: study by Boudriot et al.: J Am Coll Cardiol. 2011; 57: 538-545. Graph obtained using the software Review Manager (RevMan), version 5.3.

Figure 5 – Studies including the left main coronary artery. Mortality at 1 year: Stent versus coronary artery bypass grafting.

The size of the boxes is proportional to the number of patients. The bars represent 95% confidence intervals. The diamond represents the synthesis of the results. Abbreviations: CABG: coronary artery bypass grafting; LE MANS: Left Main Coronary Artery Stenting; SYNTAX LM: left main coronary artery subgroup of SYNTAX (Synergy between PCI with Taxus and Cardiac Surgery); PRECOMBAT: Premier of Randomized Comparison of Bypass Surgery versus Angioplasty Using Sirolimus-Eluting Stent in Patients with Left Main Coronary Artery Disease; EXCEL: Coronary Artery Bypass Surgery for Effectiveness of Left Main Revascularization; NOBLE: Nordic-Baltic-British Left Main Revascularization Study; Boudriot: study by Boudriot et al.: J Am Coll Cardiol. 2011; 57: 538-545. Graph obtained using the software Review Manager (RevMan), version 5.3.

Discussion

Several systematic reviews, collaborative studies, and meta-analyses13-18 have been published comparing PCI and CABG. The most important ones included studies of the balloon and bare-metal stent era or left out important recent studies.14-16 The main differential of the present meta-analysis is the large number of included studies and patients and the fact that it is up-to-date and included only trials of the drug-eluting stent era.
In the evaluation of the results, it is important to highlight the superiority of PCI in the mortality at 30 days. This is in line with a prior systematic review and with the New York registry. The difference is obviously not applicable to patients with lesions of high angiographic complexity, as seen in the analysis of the survival curves of aggregated results from SYNTAX LM and PRECOMBAT. A greater incidence of stroke in the surgical group had already been suggested in prior systematic reviews, and in the light of the data presented here, this fact becomes indisputable. It is worth mentioning a reduced incidence of stroke in more recent studies, reflecting a greater care taken by surgeons while manipulating the aorta. The similarity of the mortality results at 1 year is aligned with a prior systematic review, and also with a recently published collaborative study. It should be emphasized that the difference found was due to the large number of patients with diabetes in the studies of the drug-eluting stent era, which disappeared in the aggregated results when these studies were excluded. These data confirm those of the collaborative study by Hlatki et al., which demonstrated a lower overall mortality at 5 years with surgery, but no difference among nondiabetic patients. We should emphasize that the study by Hlatki et al. included trials of the balloon era in which two-vessel disease predominated, while in the present review there was a predominance of three-vessel disease and obstruction of the left main coronary artery.

In regards to the results of obstruction of the left main coronary artery, it is important to remember that the group of patients with this type of obstruction comprised for a long time a forbidden territory for angioplasty. LE MANS was the first randomized study that attempted to compare stent and surgery in left main coronary artery obstruction, with results similar or even superior to those with PCI. However, this was a small study (105 patients), which has been criticized for not having used grafting of internal thoracic artery in approximately 25% of the cases. After that, emerged the results of the SYNTAX subgroup with left main coronary artery obstruction and of the PRECOMBAT trial and the study by Boudriot et al., which led to the improvement of the recommendations of PCI in left main artery obstruction. Despite that, the American guidelines only changed the recommendation to IIA in patients with a low SYNTAX score and IIB in patients with intermediate SYNTAX scores. We should emphasize that such recommendations are restricted to patients with a high surgical risk. In the present study, which combined the results of six studies with 4700 patients, the outcomes of PCI with drug-eluting stents were equal or even greater than those with CABG. In light of these evidence and recent results of NOBLE and EXCEL, we believe that the American and Brazilian guidelines may be soon modified to improve the classification of PCI with drug-eluting stents, mainly in left main coronary artery obstruction.

In relation to the results in patients with diabetes, it is important to remember that the evidence contrary to PCI in diabetes has its origin in the balloon era, from occasional...
Stent versus surgery: randomized trials

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Effectiveness of Left Main Revascularization. Graph obtained using the software Review Manager (RevMan), version 5.3.

Figure 7 – Combined adverse events outcomes (major adverse cardiovascular and cerebrovascular disease events, MACCE) in subgroups in five studies. The size of each box is proportional to the number of patients in the subgroup. The bar is equal to the confidence interval. The diamonds represent the synthesis of the results. In the SYNTAX, FREEDOM, and EXCEL, the combined events were death, acute myocardial infarction (AMI), and stroke.

In the remaining studies, they were death, AMI, and new revascularization.

Abbreviations: CABG: coronary artery bypass grafting; SYNTAX: Synergy between PCI with Taxus and Cardiac Surgery; FREEDOM: Future Revascularization Evaluation in Patients with Diabetes Mellitus; PRECOMBAT: Premier of Randomized Comparison of Bypass Surgery versus Angioplasty Using Sirolimus-Eluting Stent in Patients with Left Main Coronary Artery Disease; EXCEL: Coronary Artery Bypass Surgery for Effectiveness of Left Main Revascularization. Graph obtained using the software Review Manager (RevMan), version 5.3.
findings of the BARI study. The investigators of this study evaluated a subgroup of 343 patients with diabetes and found a late mortality of 34.5% for PCI with balloon and 19.4% for surgery ($p = 0.03$). In the era of conventional stent, studies such as SoS and ARTS have confirmed a trend toward greater mortality with PCI in patients with diabetes, even though it did not reach statistical significance. From there onwards, the presence of diabetes has become a criterion for preferential indication of surgery as a method for myocardial revascularization. There used to be a hypothesis that drug-eluting stents would eliminate the differences in mortality found in these studies, but the results presented here demonstrate that the difference in mortality between PCI and surgery in patients with diabetes continues in the era of drug-eluting stents. However, it should be noted a reduced risk difference compared with previous studies (3.5% risk difference as opposed to 7.3% in the study by Hclatki et al. and 15.1% in BARI). This should raise the hypothesis that it is not the metabolic disorder in itself, but the complexity of the lesions which is the factor leading to a higher mortality of angioplasty in patients with diabetes. This question could perhaps be explained by a meta-analysis of individual patient data involving a large number of studies. In this sense, a recent collaborative study categorizing the results of three studies (SYNTAX, BEST, and PRECOMBAT) corroborated this hypothesis.24

### Table 1 – Overview of randomized studies comparing percutaneous coronary intervention (PCI) and coronary artery bypass grafting (CABG) in the era of drug-eluting stents

<table>
<thead>
<tr>
<th>Study</th>
<th>Origin</th>
<th>Year of publication</th>
<th>Number of patients</th>
<th>Disease extension</th>
<th>Patients with diabetes(%)</th>
<th>Unstable angina(%)</th>
<th>Mean ejection fraction (%)</th>
<th>Type of stent</th>
<th>Follow-up Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>LEMANS</td>
<td>Poland</td>
<td>2008</td>
<td>105</td>
<td>LMCA</td>
<td>25</td>
<td>32</td>
<td>53 ± 11</td>
<td>BMS and DES</td>
<td>10</td>
</tr>
<tr>
<td>SYNTAX</td>
<td>International</td>
<td>2009</td>
<td>1800</td>
<td>LMCA and three-vessel disease</td>
<td>35</td>
<td>28</td>
<td>ND ‡</td>
<td>SF</td>
<td>5</td>
</tr>
<tr>
<td>CARDia</td>
<td>United Kingdom</td>
<td>2010</td>
<td>510</td>
<td>Two- and three-vessel disease</td>
<td>100</td>
<td>22</td>
<td>59 ± 14</td>
<td>BMS and DES</td>
<td>5</td>
</tr>
<tr>
<td>Boudriot et al.</td>
<td>Germany</td>
<td>2011</td>
<td>201</td>
<td>LMCA</td>
<td>30</td>
<td>ND</td>
<td>ND</td>
<td>DES</td>
<td>1</td>
</tr>
<tr>
<td>PRECOMBAT</td>
<td>South Korea</td>
<td>2011</td>
<td>600</td>
<td>LMCA</td>
<td>42</td>
<td>45</td>
<td>60 ± 9</td>
<td>DES</td>
<td>5</td>
</tr>
<tr>
<td>FREEDOM</td>
<td>International</td>
<td>2012</td>
<td>1900</td>
<td>Two- and three-vessel disease</td>
<td>100</td>
<td>30</td>
<td>65 ± 12</td>
<td>DES</td>
<td>5</td>
</tr>
<tr>
<td>Va-Cards</td>
<td>USA</td>
<td>2013</td>
<td>198</td>
<td>Two- and three-vessel disease</td>
<td>100</td>
<td>ND</td>
<td>ND†</td>
<td>DES</td>
<td>2</td>
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<tr>
<td>BEST</td>
<td>South Korea</td>
<td>2015</td>
<td>880</td>
<td>Two- and three-vessel disease</td>
<td>45</td>
<td>42</td>
<td>59 ± 9</td>
<td>DES</td>
<td>5</td>
</tr>
<tr>
<td>EXCEL</td>
<td>International</td>
<td>2016</td>
<td>1905</td>
<td>LMCA</td>
<td>25</td>
<td>37</td>
<td>57 ± 10</td>
<td>DES</td>
<td>3</td>
</tr>
<tr>
<td>NOBLE</td>
<td>Europe</td>
<td>2016</td>
<td>982</td>
<td>LMCA</td>
<td>18</td>
<td>18</td>
<td>60 ± 10</td>
<td>DES</td>
<td>5</td>
</tr>
</tbody>
</table>

*SYNTAX: Synergy between PCI with Taxus and Cardiac Surgery; CARDia: Coronary Artery Revascularization in Diabetes; LEMANS: Left Main Coronary Artery Stenting; FREEDOM: Future Revascularization Evaluation in Patients with Diabetes Mellitus; VA CARDS: Coronary Artery Revascularization in Diabetes; BEST: Bypass Surgery and Everolimus-Eluting Stent Implantation in the Treatment of Patients with Multivessel Coronary Artery Disease; PRECOMBAT: Premier of Randomized Comparison of Bypass Surgery versus Angioplasty Using Sirolimus-Eluting Stent in Patients with Left Main Coronary Artery Disease; EXCEL: Coronary Artery Bypass Surgery for Effectiveness of Left Main Revascularization; NOBLE: Nordic-Baltic-British Left Main Revascularization Study; Boudriot study by Boudriot et al.: J Am Coll Cardiol. 2011; 57: 538-545; DES: drug-eluting stent; BMS: bare-metal stent; LMCA: left main coronary artery; USA: United States. †: 37% with ejection fraction < 55%; ‡: 3% with ejection fraction < 30%.*
The MACCE outcomes in subgroups (Figure 7) in the present study demonstrate that the SYNTAX score in the upper tertile strongly and negatively influenced the PCI outcomes, similarly to the presence of diabetes. The elderly condition and the female gender had a small influence on the results; an ejection fraction < 50% did not negatively influence the PCI outcomes, but an ejection fraction < 35% had a greater impact, even though it had no statistical significance. These results are in agreement with those of the collaborative study by Cavalcante et al.\textsuperscript{20} In that study, by aggregating the results of the SYNTAX LEFT MAIN and PRECOMBAT for combined adverse events (death, stroke, AMI, and new revascularization), a high SYNTAX score, like diabetes, had an important role. The female gender, elderly condition, ejection fraction < 50%, and renal insufficiency did not negatively affect the results compared with PCI. This same study showed that the subgroups most significantly affecting PCI-associated mortality outcomes in obstruction of the left main coronary artery were those with two- or three-vessel disease and with a SYNTAX score > 32. Diabetes had a less important role, possibly related to the fact that only patients with left main coronary artery obstruction were evaluated.

### Study limitations

This study has important limitations. Because the meta-analysis included published data rather than individual patient data, we were unable to analyze the mortality outcomes in subgroups, except in those with diabetes. Additionally, the percentages had to be processed as absolute numbers, which may deserve criticism. The results apply only to patients in whom revascularization is possible by both methods and without a high surgical risk or history of prior surgical revascularization, and with the procedures carried out in institutions of excellence.

### Conclusion

In combined results of randomized studies involving multivessel disease or obstruction of the left main coronary artery, PCI with drug-eluting stent was associated with a lower incidence of stroke, lower mortality at 30 days, and increased late mortality when compared with CABG. There was no difference in early, intermediate, or late mortality in the subgroup with left main coronary obstruction, but there was a difference in favor of PCI in regards to the incidence of stroke. The presence of diabetes and a high SYNTAX score were factors most strongly and negatively impacting PCI outcomes in terms of combined adverse results.

### Author contributions

Conception and design of the research: Andrade PJN. Acquisition of data: Andrade PJN, Falcão JLAA, Andrade AT, Falcão BAA. Analysis and interpretation of the data: Andrade PJN, Rocha HAL, Falcão JLAA, Andrade AT. Statistical analysis: Rocha HAL. Writing of the manuscript: Andrade PJN, Rocha HAL, Falcão JLAA, Falcão BAA. Critical revision of the manuscript for intellectual content: Andrade PJN, Falcão BAA. Supervision as the major investigator: Andrade PJN.

### Potential Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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### Study Association

This study is not associated with any thesis or dissertation work.

### Ethics approval and consent to participate

This article does not contain any studies with human participants or animals performed by any of the authors.
References


