Revascularization strategies in patients with ST-segment elevation myocardial infarction and multivessel coronary artery disease: urgent or staged?

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Approximately 50% of patients with ST-segment elevation myocardial infarction (STEMI) who undergo primary percutaneous coronary intervention (PCI) have multivessel (MV) coronary artery disease (CAD) (1). These patients have higher risk of mortality in comparison with patients with single vessel CAD.

Up to date, several retrospective studies and few randomized trials have compared the different strategies of revascularization of these patients (Table 1), including: (I) infarct-related artery (IRA)-only PCI; (II) single procedure MV-PCI; and (III) staged MV-PCI, defined as PCI limited to the IRA during the index procedure followed by planned PCI of significant non-IRA lesions at a different time. However, most randomized trials were either underpowered for comparing the three revascularization strategies or compared only one type of complete revascularization. Therefore, up to 15 meta-analysis (6-20) have been conducted in order to clarify this issue (Figure 1), concluding most of them that complete revascularization is associated to a reduced need of new revascularizations, although no clear benefit of revascularization strategy respect to another one in terms of mortality has been demonstrated thus far.

<table>
<thead>
<tr>
<th>Trial</th>
<th>First author</th>
<th>N</th>
<th>Strategy</th>
<th>Primary endpoint</th>
<th>HR</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRAMI</td>
<td>Wald et al. (2)</td>
<td>465</td>
<td>IRA-only PCI vs. single-procedure MV-PCI</td>
<td>Combined incidence of death from cardiac causes, nonfatal MI, or refractory angina</td>
<td>0.35; 95% CI, 0.21–0.58</td>
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<tr>
<td>CvLPRIT</td>
<td>Gershick et al. (3)</td>
<td>296</td>
<td>IRA-only PCI vs. single-procedure MV-PCI</td>
<td>Composite of all-cause death, recurrent MI, heart failure, and ischemia-driven revascularization within 12 months</td>
<td>0.45; 95% CI, 0.24–0.84</td>
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<tr>
<td>DANAMI-3</td>
<td>Engstrøm et al. (4)</td>
<td>627</td>
<td>IRA-only PCI vs. FFR-guided staged MV-PCI</td>
<td>Composite of all-cause mortality, non-fatal reinfarction, and ischaemia-driven revascularization of lesions in non-IRA</td>
<td>0.56; 95% CI, 0.38–0.83</td>
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<tr>
<td>PRAGUE-13</td>
<td>Hlinomaz et al. (5)</td>
<td>214</td>
<td>IRA-only PCI vs. staged MV-PCI</td>
<td>Composite of all-cause death, nonfatal MI and stroke</td>
<td>0.91; 95% CI, 0.30–2.70</td>
</tr>
</tbody>
</table>

IRA, infarct-related artery; PCI, percutaneous coronary intervention; MV, multivessel; MI, myocardial infarction; CI, confidence interval; HR, hazard ratio.
Figure 1 Summary of odds ratios (OR) and 95% confidence intervals (CI) obtained in every meta-analysis for long-term mortality. (A) Comparisons between any type of complete revascularization and infarct related (IRA)-only revascularization; (B) comparisons between staged complete revascularization and IRA-only revascularization; (C) comparisons between staged complete revascularization and multivessel (MV) revascularization during the index procedure.
To solve this question, Tarantini et al. (7) conducted a pairwise and network meta-analysis of the three PCI strategies in patients with STEMI and MV disease. They identified 13 prospective and 19 retrospective studies including 54,148 patients. As result, there were 18 comparisons for IRA-only PCI versus single procedure MV-PCI; 15 comparisons for IRA-only versus staged MV-PCI; and nine comparisons for staged MV-PCI versus IRA-only PCI. The primary outcome of the meta-analysis was all-cause mortality. The researchers stratified the outcomes on pooled short-term mortality and pooled long-term mortality. In the pooled short-term mortality analysis, staged MV-PCI was associated with lower mortality in comparison with IRA-only PCI (1.9% vs. 4.9%, P=0.02), and in comparison with single-procedure MV-PCI (1.4% vs. 5.6%, P<0.001). IRA-only PCI was associated with lower mortality in comparison with single-procedure MV-PCI (4.9% vs. 6.9%, P=0.004). In the pooled long-term mortality analysis, lower mortality was shown in the staged MV-PCI strategy versus IRA-only PCI (4.1% vs. 6.8%, P=0.001) and in comparison with single-procedure MV-PCI (3.1% vs. 8.5%, P=0.0001). IRA-only PCI was associated with lower mortality in comparison with single-procedure MV-PCI (6.9% vs. 8.0%, P=0.04). The profit of staged MV-PCI continued after excluding patients with cardiogenic shock in comparison with both IRA-only and single-procedure MV-PCI, but no differences were found between IRA-only PCI and single-procedure MV-PCI.

Notably, this meta-analysis is the first to show that a staged MV-PCI is superior to a single-procedure MV-PCI in terms of mortality. However, as acknowledged by the researchers, many of the studies included were retrospective, and the decision to perform any strategy was driven by local and operator practice. Unfortunately, this conclusion, which would represent excellent news for the interventional community considering the complexity of MV-PCI in the setting of a STEMI, has not been confirmed by other recent meta-analysis that used only data from randomized clinical trials. Indeed, Shah et al. (8), using data from nine randomized trials conclude that MV-PCI either during primary PCI or as an staged procedure resulted in lower occurrences of major adverse cardiac events, revascularization, and cardiovascular mortality than IRA-only PCI. Because single-procedure MV-PCI also resulted in lower rates of recurrent myocardial infarction, they recommended single-procedure MV-PCI as the most efficacious revascularization strategy of the 3. Altogether, the meta-analyses performed by Tarantini et al. (7) and Shah et al. (8) are in agreement with a recent update of the American College of Cardiology and American Heart Association guidelines for patients with STEMI, that recommended complete revascularization (either at the index procedure or as a staged procedure) as a class IIB indication.

Of note, single-procedure MV-PCI may be associated to several advantages. First, it may increase myocardial salvage by increasing perfusion to watershed areas by relieving flow limiting stenosis in the non-IRA. Second, it is associated to lower rates of recurrent myocardial infarction by stabilizing other bystander vulnerable plaques. Third, it may reduce vascular complications from repeated vascular punctures which are required in a staged MV-PCI. Finally, it may be cost-effective by reducing the need of new devices in staged procedures as well as repeated hospitalizations. By contrast, as compared to staged MV-PCI, single-procedure MV-PCI may be associated to some disadvantages such as: (I) the use of high contrast volume, therefore increasing the risk of contrast-induced nephropathy and heart failure; (II) the use of high radiation dose; (III) operator fatigue, especially in working off-hours, may increase the risk of procedural complications.

In conclusion, given that a complete revascularization approach seem to improve survival, the question remaining to be answered by appropriately designed and powered clinical trials is when, not whether, complete revascularization should be performed.

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Footnote
Conflict of Interest: The authors have no conflicts of interest to declare.

References


