Complete Revascularization in STEMI Patients

A look at when and how to perform complete revascularization versus when to leave revascularization incomplete.

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Approximately 40% to 50% of patients presenting with acute ST-segment elevation myocardial infarction (STEMI) have multivessel coronary artery disease, a condition associated with worse clinical outcomes compared with patients showing a single coronary lesion.[1] Although primary percutaneous coronary intervention (PCI) of the culprit lesion with drug-eluting stents is the gold standard for patients with STEMI, the optimal revascularization strategy for nonculprit lesions remains controversial.[2]

Recent evidence supports the benefit of complete revascularization compared with culprit-only PCI in patients with STEMI and multivessel disease. The most commonly adopted strategy for complete revascularization is a staged procedure after culprit-only PCI in the acute setting, probably with a similar clinical advantage with either in-hospital or short-term postdischarge staged PCI.[3] Despite its potential advantages, the immediate complete revascularization approach during the index procedure remains poorly evaluated. This article evaluates the existing clinical data and the appropriate scenarios for revascularization.

CLINICAL DATA

Complete revascularization has been observed to provide a clinical benefit compared with the culprit-only approach in several randomized studies that have evaluated revascularization strategies in patients presenting with STEMI and multivessel disease and without cardiogenic shock.[4-7] In particular, initial observations reported lower rates of soft composite clinical endpoints, including revascularization and angina pectoris.[4-7]

However, the recently published COMPLETE trial demonstrated a major advantage of complete revascularization for cardiovascular death or myocardial infarction (MI) when compared with culprit-only PCI. This study also confirmed, in a very large population, a reduced composite endpoint of cardiovascular death, MI, or ischemia-driven revascularization when a complete revascularization approach was adopted.[8] This benefit was mainly driven by significant reductions in MI and ischemia-driven revascularization. Conversely, there was a nonsignificant reduction in the occurrence of cardiovascular mortality, heart failure, and all-cause mortality between the groups. Major bleeding and contrast-induced acute kidney injury showed only a small nonsignificant increase in the complete revascularization group. Given these results, a complete revascularization strategy appears to be the gold standard for treating patients with STEMI and multivessel coronary disease.

However, the optimal timing to perform complete revascularization remains debatable. The CvLPRIT trial only showed a trend of reduced repeated revascularization risk when the complete revascularization was performed during the index procedure.[5] In the timing substudy of the COMPLETE trial, the benefit of complete revascularization emerged over longer-term follow-up and was observed when nonculprit-lesion PCI was performed either during the index hospitalization or after hospital discharge, although no direct comparison between the two strategies was carried out.[3]

Theoretically, the early completion of coronary revascularization might reduce the occurrence of events due to nonculprit lesions, and an immediate approach could reduce costs and the risks of a second procedure. However, immediate complete revascularization might increase procedural time and contrast delivery during the acute phase.

Several studies are currently evaluating the feasibility of an immediate complete revascularization strategy in a randomized fashion. The MULTISTARS AMI trial (NCT03135275) is investigating the safety and efficacy of immediate complete revascularization versus staged complete PCI in patients with STEMI and multivessel disease. The BIOVASC trial (NCT03621501) is comparing ad hoc complete versus staged complete revascularization in patients with acute coronary syndrome (ACS) and multivessel disease.

WHEN AND WHY TO LEAVE REVASCULARIZATION INCOMPLETE

The routine revascularization of noninfarct-related artery (non-IRA) lesions during primary PCI is not recommended (class of recommendation, III; level of evidence, B) in patients with ACS and cardiogenic shock.[2] The CULPRIT-SHOCK trial demonstrated that culprit-only PCI with a possible staged revascularization strategy reduced the composite endpoint of mortality and severe renal failure at 30 days compared with immediate multivessel PCI.[9] The reduction was mainly driven by all-cause mortality, without significant difference in renal failure. The exploratory results at 1 year showed no significant difference in mortality between the two approaches between 30 days and 1 year, and culprit-only PCI was associated with a higher incidence of repeat revascularizations and a higher rate of heart failure hospitalizations.[10] Approximately 50% of the patients required resuscitation before PCI, but neurologic outcomes were not reported.[9] The CULPRIT-SHOCK trial recommended chronic total occlusion (CTO) PCI as part of a complete strategy. CTO PCI was attempted in roughly 50% of patients and was successful in approximately one-third of the patients.[11] In the setting of cardiogenic shock, the benefit of revascularizing CTOs is unclear, and the revascularization of these lesions may have contributed to the worse outcomes observed in the multivessel PCI arm.

When approaching patients with cardiogenic shock in routine clinical practice, revascularization should be limited to the culprit lesion in the acute phase, deferring the intervention in nonculprit stenosis to a later time point when the patient is hemodynamically stable. However, immediate multivessel PCI might be justified in the case of an unclear culprit, when multiple culprit lesions are identified, or in the presence of flow-limiting non-IRA subtotal stenosis supplying a large myocardial area.[12]

WHEN TO REVASCULARIZE BEYOND THE CULPRIT LESION

The term *culprit lesion* is used to designate the coronary stenosis that is considered responsible for the ACS. Nonculprit lesions are all the significant coronary stenoses not identified as responsible for the acute event. Different definitions have been adopted in trials. In the COMPLETE study, angiographic significance was defined as ≥ 70% stenosis of the vessel diameter on visual estimation or 50% to 69% stenosis but with a positive fractional flow reserve measurement.[8]

In addition to the functional assessment of the nonculprit lesions, coronary imaging assessment might help redefine culprit and nonculprit lesions. In the COMPLETE trial, optical coherence tomography was performed in 93 patients on nonculprit vessels, showing a thin-cap fibroelastoma in 39% of obstructive lesions and 27% of the nonobstructive lesions.[13]

Finally, the simultaneous presence of multiple unstable plaques has been previously described, possibly reflecting a generalized coronary inflammation status during the acute phase.[14] Intracoronary imaging might be particularly relevant in the assessment of such diffused inflammatory and prothrombotic milieu and might guide an immediate complete revascularization approach.

CONCLUSION

Complete revascularization is becoming the gold standard for the treatment of patients presenting with STEMI and multivessel disease and without cardiogenic shock. The optimal timing to perform the complete revascularization remains unclear. Ongoing trials will further elucidate the impact of an immediate or staged complete approach on clinical outcomes. ■

1. Park DW, Clare RM, Schulte PJ, et al. Extent, location, and clinical significance of non-infarct-related coronary artery disease among patients with ST-elevation myocardial infarction. JAMA. 2014;312:2019-2027. doi: 10.1001/jama.2014.15095
2. Neumann FJ, Sousa-Uva M, Ahlsson A, et al. 2018 ESC/EACTS guidelines on myocardial revascularization. Eur Heart J. 2019;40:87-165. doi: 10.1093/eurheartj/ehy394
3. Wood DA, Cairns JA, Wang J, et al. Timing of staged nonculprit artery revascularization in patients with ST-segment elevation myocardial infarction: COMPLETE trial. J Am Coll Cardiol. 2019;74:2713-2723. doi: 10.1016/j.jacc.2019.09.051
4. Wald DS, Morris JK, Wald NJ, et al. Randomized trial of preventive angioplasty in myocardial infarction. N Engl J Med. 2013;369:1115-1123. doi: 10.1056/NEJMoa1305520
5. Gershlick AH, Khan JN, Kelly DJ, et al. Randomized trial of complete versus lesion-only revascularization in patients undergoing primary percutaneous coronary intervention for STEMI and multivessel disease: the CvLPRIT trial. J Am Coll Cardiol. 2015;65:963-972. doi: 10.1016/j.jacc.2014.12.038
6. Engstrøm T, Kelbæk H, Helqvist S, et al. Complete revascularisation versus treatment of the culprit lesion only in patients with ST-segment elevation myocardial infarction and multivessel disease (DANAMI-3-PRIMULTI): an open-label, randomised controlled trial. Lancet. 2015;386:665-671. doi: 10.1016/s0140-6736(15)60648-1
7. Smits PC, Abdel-Wahab M, Neumann FJ, et al. Fractional flow reserve-guided multivessel angioplasty in myocardial infarction. N Engl J Med. 2017;376:1234-1244. doi: 10.1056/NEJMoa1701067
8. Mehta SR, Wood DA, Storey RF, et al. Complete revascularization with multivessel PCI for myocardial infarction. N Engl J Med. 2019;381:1411-1421. doi: 10.1056/NEJMoa1907775
9. Thiele H, Akin I, Sandri M, et al. PCI strategies in patients with acute myocardial infarction and cardiogenic shock. N Engl J Med. 2017;377:2419-2432. doi: 10.1056/NEJMoa1710261
10. Thiele H, Akin I, Sandri M, et al. One-year outcomes after PCI strategies in cardiogenic shock. N Engl J Med. 2018;379:1699-1710. doi: 10.1056/NEJMoa1808788
11. Thiele H, Desch S. CULPRIT-SHOCK (culprit lesion only PCI versus multivessel percutaneous coronary intervention in cardiogenic shock): implications on guideline recommendations. Circulation. 2018;137:1314-1316. doi: 10.1161/CIRCULATIONAHA.117.032907
12. Ibanez B, Halvorsen S, Roffi M, et al. Integrating the results of the CULPRIT-SHOCK trial in the 2017 ESC ST-elevation myocardial infarction guidelines: viewpoint of the task force. Eur Heart J. 2018;39:4239-4242. doi: 10.1093/eurheartj/ehy294
13. Pinilla-Echeverri N, Mehta SR, Wang J, et al. Non-culprit lesion plaque morphology in patients with ST-segment elevation myocardial infarction: results from the COMPLETE trial optical coherence tomography (OCT) substudy. Presented at: American Heart Association 2019 Scientific Sessions; November 16-18, 2019; Philadelphia, Pennsylvania.
14. Kubo T, Imanishi T, Kashiwagi M, et al. Multiple coronary lesion instability in patients with acute myocardial infarction as determined by optical coherence tomography. Am J Cardiol. 2010;105:318-322. doi: 10.1016/j.amjcard.2009.09.032

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