2015 ACC/AHA/SCAI Focused Update on Primary Percutaneous Coronary Intervention for Patients With ST-Elevation Myocardial Infarction: An Update of the 2011 ACCF/AHA/SCAI Guideline for Percutaneous Coronary Intervention and the 2013 ACCF/AHA Guideline for the Management of ST-Elevation Myocardial Infarction

A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines and the Society for Cardiovascular Angiography and Interventions

Developed in Collaboration With the American College of Emergency Physicians

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This document was approved by the American College of Cardiology Board of Trustees and Executive Committee, the American Heart Association Science Advisory and Coordinating Committee, and the Society of Cardiovascular Angiography and Interventions in September 2015, and the American Heart Association Executive Committee in October 2015.

The online-only Comprehensive RWI Data Supplement table is available with this article at http://circ.ahajournals.org/lookup/suppl/doi:10.1161/CIR.0000000000000336/-/DC1.

The online-only Data Supplement is available with this article at http://circ.ahajournals.org/lookup/suppl/doi:10.1161/CIR.0000000000000336/-/DC2.

The American Heart Association requests that this document be cited as follows: Levine GN, O'Gara PT, Bates ER, Blankenship JC, Kushner FG, Bailey SR, Bittl JA, Brindis RG, Casey DE Jr, Cercek B, Chambers CE, Chung MK, de Lemos JA, Diercks DB, Ellis SG, Fang JC, Franklin BA, Granger CB, Guyton RA, Hollenberg SM, Khot UN, Krumholz HM, Lange RA, Linderbaum JA, Mauri L, Mehran R, Morrow DA, Moussa ID, Mukherjee D, Newby LK, Ornato JP, Ou N, Radford MJ, Tamis-Holland JE, Ting HH, Tommaso CL, Tracy CM, Woo YJ, Zhao DX. 2015 ACC/AHA/SCAI focused update on primary percutaneous coronary intervention for patients with ST-elevation myocardial infarction: an update of the 2011 ACCF/AHA/SCAI guideline for percutaneous coronary intervention and the 2013 ACCF/AHA guideline for the management of ST-elevation myocardial infarction: a report of the American College of Cardiology Foundation/American Heart Association Task Force on Clinical Practice Guidelines and the Society for Cardiovascular Angiography and Interventions. *Circulation.* 2015.●●:●●●●–●●●●.

This article has been copublished in *Journal of the American College of Cardiology* and *Catheterization and Cardiovascular Interventions*.

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(*Circulation*. 2015;000:000–000.)

***Circulation* is available at http://circ.ahajournals.org**

DOI: 10.1161/CIR.0000000000000336

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Preamble

To ensure that guidelines reflect current knowledge, available treatment options, and optimum medical care, existing clinical practice guideline recommendations are modified and new recommendations are added in response to new data, medications or devices. To keep pace with evolving evidence, the American College of Cardiology (ACC) / American Heart Association (AHA) Task Force on Clinical Practice Guidelines ("Task Force") has issued this focused update to revise guideline recommendations on the basis of recently published data. This update is not based on a complete literature review from the date of previous guideline publications, but it has been subject to rigorous, multilevel review and approval, similar to the full guidelines. For specific focused update criteria and additional methodological details, please see the ACC/AHA guideline methodology manual (1).

Modernization

In response to published reports from the Institute of Medicine (2,3) and ACC/AHA mandates (4-7), processes have changed leading to adoption of a "knowledge byte" format. This entails delineation of recommendations addressing specific clinical questions, followed by concise text, with hyperlinks to supportive evidence. This approach better accommodates time constraints on busy clinicians, facilitates easier access to recommendations via electronic search engines and other evolving technology (e.g., smart phone apps), and supports the evolution of guidelines as "living documents" that can be dynamically updated as needed.

Intended Use

Practice guidelines provide recommendations applicable to patients with or at risk of developing cardiovascular disease. The focus is on medical practice in the United States, but guidelines developed in collaboration with other organizations may have a broader target. Although guidelines may inform regulatory or payer decisions, they are intended to improve quality of care in the interest of patients.

Class of Recommendation and Level of Evidence

The Class of Recommendation (COR) and Level of Evidence (LOE) are derived independently of one another according to established criteria. The COR indicates the strength of recommendation, encompassing the estimated magnitude and certainty of benefit of a clinical action in proportion to risk. The LOE rates the quality of scientific evidence supporting the intervention on the basis of the type, quantity, and consistency of data from clinical trials and other sources (Table 1) (1,7,8).

Relationships With Industry and Other Entities

The ACC and AHA sponsor the guidelines without commercial support, and members volunteer their time. The Task Force zealously avoids actual, potential, or perceived conflicts of interest that might arise through

relationships with industry or other entities (RWI). All Guideline Writing Committee (GWC) members and reviewers are required to disclose current industry relationships or personal interests from 12 months before initiation of the writing effort. Management of RWI involves selecting a balanced GWC and assuring that the chair and a majority of committee members have no relevant RWI (Appendixes 1 and 2). Members are restricted with regard to writing or voting on sections to which their RWI apply. For transparency, members' comprehensive disclosure information is available online (http://circ.ahajournals.org/lookup/suppl/doi:10.1161/CIR.0000000000000336/-/DC1). Comprehensive disclosure information for the Task Force is available at http://www.acc.org/guidelines/about-guidelines-and-clinical-documents/guidelines-and-documents-task-forces. The Task Force strives to avoid bias by selecting experts from a broad array of backgrounds representing different geographic regions, sexes, ethnicities, intellectual perspectives/biases, and scopes of clinical practice, and by inviting organizations and professional societies with related interests and expertise to participate as partners or collaborators.

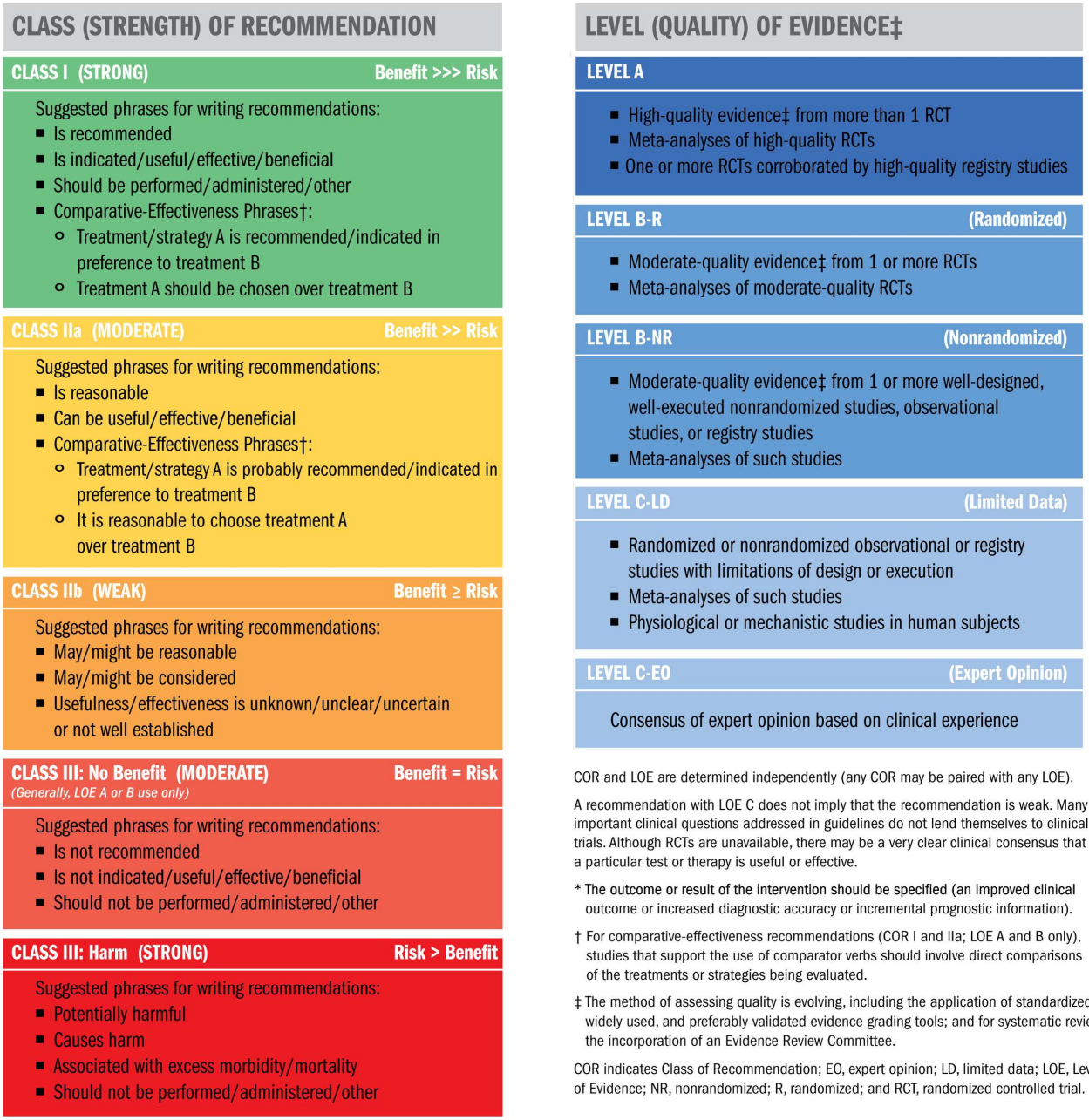
Related Issues

For additional information pertaining to the methodology for grading evidence, assessment of benefit and harm, shared decision making between the patient and clinician, structure of evidence tables and summaries, standardized terminology for articulating recommendations, organizational involvement, peer review, and policies for periodic assessment and updating of guideline documents, we encourage readers to consult the ACC/AHA guideline methodology manual (1).

The recommendations in this focused update represent the official policy of the ACC and AHA until superseded by published addenda, statements of clarification, focused updates, or revised full-text guidelines. To ensure that guidelines remain current, new data are reviewed biannually to determine whether recommendations should be modified. In general, full revisions are posted in 5-year cycles (1).

Jonathan L. Halperin, MD, FACC, FAHA
Chair, ACC/AHA Task Force on Clinical Practice Guidelines

Table 1. Applying Class of Recommendation and Level of Evidence to Clinical Strategies, Interventions, Treatments, or Diagnostic Testing in Patient Care* (Updated August 2015)



COR and LOE are determined independently (any COR may be paired with any LOE).

A recommendation with LOE C does not imply that the recommendation is weak. Many important clinical questions addressed in guidelines do not lend themselves to clinical trials. Although RCTs are unavailable, there may be a very clear clinical consensus that a particular test or therapy is useful or effective.

* The outcome or result of the intervention should be specified (an improved clinical outcome or increased diagnostic accuracy or incremental prognostic information).

† For comparative-effectiveness recommendations (COR I and IIa; LOE A and B only), studies that support the use of comparator verbs should involve direct comparisons of the treatments or strategies being evaluated.

‡ The method of assessing quality is evolving, including the application of standardized, widely used, and preferably validated evidence grading tools; and for systematic reviews, the incorporation of an Evidence Review Committee.

COR indicates Class of Recommendation; EO, expert opinion; LD, limited data; LOE, Level of Evidence; NR, nonrandomized; R, randomized; and RCT, randomized controlled trial.

1. Introduction

The scope of this focused update is limited to considerations relevant to multivessel percutaneous coronary intervention (PCI) and thrombus aspiration in patients with ST-elevation myocardial infarction (STEMI) undergoing primary PCI.

1.1. Methodology and Evidence Review

Clinical trials presented at the major cardiology organizations' 2013 to 2015 annual scientific meetings and other selected reports published in a peer-reviewed format through August 2015 were reviewed by the 2011 PCI and 2013 STEMI GWCs and the Task Force to identify trials and other key data that might affect guideline recommendations. The information considered important enough to prompt updated recommendations is included in evidence tables in the Online Data Supplement (http://circ.ahajournals.org/lookup/suppl/doi:10.1161/CIR.0000000000000336/-/DC2).

Consult the full-text versions of the 2011 PCI and 2013 STEMI guidelines (9,10) for recommendations in clinical areas not addressed in the focused update. The individual recommendations in this focused update will be incorporated into future revisions or updates of the full-text guidelines.

1.2. Organization of the GWC

For this focused update, representative members of the 2011 PCI and 2013 STEMI GWCs were invited to participate. Members were required to disclose all RWI relevant to the topics under consideration. The entire membership of both GWCs voted on the revised recommendations and text. The latter group was composed of experts representing cardiovascular medicine, interventional cardiology, electrophysiology, heart failure, cardiac surgery, emergency medicine, internal medicine, cardiac rehabilitation, nursing, and pharmacy. The GWC included representatives from the ACC, AHA, American College of Physicians, American College of Emergency Physicians, and Society for Cardiovascular Angiography and Interventions (SCAI).

1.3. Review and Approval

This document was reviewed predominantly by the prior reviewers from the respective 2011 and 2013 guidelines. These included 8 official reviewers jointly nominated by the ACC and AHA, 4 official/organizational reviewers nominated by SCAI, and 25 individual content reviewers. Reviewers' RWI information was distributed to the GWC and is published in this document (Appendix 3).

This document was approved for publication by the governing bodies of the ACC, the AHA, and the SCAI and was endorsed by the (TBD).

2. Culprit Artery–Only Versus Multivessel PCI

(See Section 5.2.2.2 of 2011 PCI guideline and Section 4.1.1 of 2013 STEMI guideline for additional recommendations.)

2013 Recommendation	2015 Focused Update Recommendation	Comment
Class III: Harm PCI should not be performed in a noninfarct artery at the time of primary PCI in patients with STEMI who are hemodynamically stable (11-13). (*Level of Evidence: B*)	**Class IIb** PCI of a noninfarct artery may be considered in selected patients with STEMI and multivessel disease who are hemodynamically stable, either at the time of primary PCI or as a planned staged procedure (11-24). *(Level of Evidence: B-R)*	Modified recommendation (changed class from "III: Harm" to "IIb" and expanded time frame in which multivessel PCI could be performed).

PCI indicates percutaneous coronary intervention; and STEMI, ST-elevation myocardial infarction.

Approximately 50% of patients with STEMI have multivessel disease (25,26). PCI options for patients with STEMI and multivessel disease include: 1) culprit artery–only primary PCI, with PCI of nonculprit arteries only for spontaneous ischemia or intermediate- or high-risk findings on predischarge noninvasive testing; 2) multivessel PCI at the time of primary PCI; or 3) culprit artery–only primary PCI followed by staged PCI of nonculprit arteries. Observational studies, randomized controlled trials (RCTs), and meta-analyses comparing culprit artery–only PCI with multivessel PCI have reported conflicting results (11,12,14-24,27,28), likely because of differing inclusion criteria, study protocols, timing of multivessel PCI, statistical heterogeneity, and variable endpoints (Data Supplement).

Previous clinical practice guidelines recommended against PCI of nonculprit artery stenoses at the time of primary PCI in hemodynamically stable patients with STEMI (9,10). Planning for routine, staged PCI of noninfarct artery stenoses on the basis of the initial angiographic findings was not addressed in these previous guidelines, and noninfarct artery PCI was considered only in the limited context of spontaneous ischemia or high-risk findings on predischarge noninvasive testing. The earlier recommendations were based in part on safety concerns, which included increased risks for procedural complications, longer procedural time, contrast nephropathy, and stent thrombosis in a prothrombotic and proinflammatory state (9,10), and in part on the findings from many observational studies and meta-analyses of trends toward or statistically significant worse outcomes in those who underwent multivessel primary PCI (12-16,21-23).

Four RCTs have since suggested that a strategy of multivessel PCI, either at the time of primary PCI or as a planned, staged procedure, may be beneficial and safe in selected patients with STEMI (17,18,24,27) (Data Supplement). In the PRAMI (Preventive Angioplasty in Acute Myocardial Infarction) trial (n=465) (24), the composite primary outcome of cardiac death, nonfatal myocardial infarction (MI), or refractory angina occurred in 21 patients (9%) treated with multivessel primary PCI, compared with 53 patients (22%) treated with culprit artery–only PCI (HR: 0.35; 95% CI: 0.21 to 0.58; p<0.001). In the CvLPRIT (Complete Versus Culprit-Lesion

Only Primary PCI) trial (18), 296 patients were randomized to culprit artery–only or multivessel PCI during the index hospitalization (72% underwent multivessel primary PCI). The composite primary outcome of death, reinfarction, heart failure, and ischemia-driven revascularization at 12 months occurred in 15 patients (10%) who underwent multivessel PCI, compared with 31 patients (21%) receiving culprit artery–only PCI (HR: 0.49; 95% CI: 0.24 to 0.84; p=0.009). In the DANAMI 3 PRIMULTI (Third Danish Study of Optimal Acute Treatment of Patients with ST-segment Elevation Myocardial Infarction) trial (17), the composite primary outcome of all-cause death, nonfatal MI, or ischemia-driven revascularization of nonculprit artery disease occurred in 40 of 314 patients (13%) who underwent multivessel staged PCI guided by angiography and fractional flow reserve before discharge, versus 68 of 313 patients (22%) treated with culprit artery–only PCI (HR: 0.56; 95% CI: 0.38 to 0.83; p=0.004). In the PRAGUE-13 (Primary Angioplasty in Patients Transferred From General Community Hospitals to Specialized PTCA Units With or Without Emergency Thrombolysis) trial (27), 214 patients with STEMI were randomized to staged (3 to 40 days after the index procedure) revascularization of all ≥70% diameter stenosis noninfarct lesions or culprit-only PCI. Preliminary results at 38 months' mean follow-up showed no between-group differences in the composite primary endpoint of all-cause death, nonfatal MI, and stroke.

On the basis of these findings (17,18,24,27), the prior Class III (Harm) recommendation with regard to multivessel primary PCI in hemodynamically stable patients with STEMI has been upgraded and modified to a Class IIb recommendation to include consideration of multivessel PCI, either at the time of primary PCI or as a planned, staged procedure. The writing committee emphasizes that this change should not be interpreted as endorsing the *routine* performance of multivessel PCI in all patients with STEMI and multivessel disease. Rather, when considering the indications for and timing of multivessel PCI, physicians should integrate clinical data, lesion severity/complexity, and risk of contrast nephropathy to determine the optimal strategy.

The preceding discussion and recommendations apply to the strategy of *routine* PCI of noninfarct related arteries in hemodynamically stable patients. Recommendations in the 2013 STEMI guideline with regard to PCI of a non–infarct-related artery at a time separate from primary PCI in patients who have spontaneous symptoms and myocardial ischemia or who have intermediate- or high-risk findings on noninvasive testing (Section 6.3 of that guideline) remain operative.

Although several observational studies (19,20) and a network meta-analysis (13) have suggested that multivessel staged PCI may be associated with better outcome than multivessel primary PCI, there are insufficient observational data and no randomized data at this time to inform a recommendation with regard to the optimal timing of nonculprit vessel PCI. Additional trial data that will help further clarify this issue are awaited. Issues related to the optimal method of evaluating nonculprit lesions (e.g., percent diameter stenosis, fractional flow reserve) are beyond the scope of this focused update.

3. Aspiration Thrombectomy

(See Section 5.5.2 of the 2011 PCI guideline and Section 4.2 of the 2013 STEMI guideline for additional recommendations.)

2011/2013 Recommendation	2015 Focused Update Recommendations	Comments
Class IIa Manual aspiration thrombectomy is reasonable for patients undergoing primary PCI (29-32). (*Level of Evidence: B*)	**Class IIb** The usefulness of selective and bailout aspiration thrombectomy in patients undergoing primary PCI is not well established (33-37). (*Level of Evidence: C-LD*)	Modified recommendation (Class changed from "IIa" to "IIb" for selective and bailout aspiration thrombectomy before PCI).
	Class III: No Benefit *Routine* aspiration thrombectomy before primary PCI is not useful (33-37). (*Level of Evidence: A)*	New recommendation ("Class III: No Benefit" added for *routine* aspiration thrombectomy before PCI).

PCI indicates percutaneous coronary intervention; and LD, limited data.

The 2011 PCI and 2013 STEMI guidelines' (9,10) Class IIa recommendation for aspiration thrombectomy before primary PCI was based on the results of 2 RCTs (29,31,32) and 1 meta-analysis (30) and was driven in large measure by the results of TAPAS (Thrombus Aspiration During Primary Percutaneous Coronary Intervention in Acute Myocardial Infarction Study), a single-center study that randomized 1,071 patients with STEMI to aspiration thrombectomy before primary PCI or primary PCI only (29,32). Three multicenter trials, 2 of which enrolled significantly more patients than prior aspiration thrombectomy trials, have prompted reevaluation of this recommendation. In the INFUSE-AMI (Intracoronary Abciximab and Aspiration Thrombectomy in Patients With Large Anterior Myocardial Infarction) trial (37) of 452 patients with anterior STEMI due to proximal or mid-left anterior descending occlusion, infarct size was not reduced by aspiration thrombectomy before primary PCI. The TASTE (Thrombus Aspiration During ST-Segment Elevation Myocardial Infarction) trial (n=7,244) incorporated a unique design that allowed randomization within an existing national registry, resulting in enrollment of a remarkably high proportion of eligible patients (34,36). No significant 30-day or 1-year differences were found between the group that received aspiration thrombectomy before primary PCI and the group that received primary PCI only with regard to death, reinfarction, stent thrombosis, target lesion revascularization, or a composite of major adverse cardiac events. The TOTAL (Trial of Routine Aspiration Thrombectomy With PCI Versus PCI Alone in Patients With STEMI) trial randomized 10,732 patients with STEMI to aspiration thrombectomy before primary PCI or primary PCI only (35). Bailout thrombectomy was performed in 7.1% of the primary PCI–only group, whereas the rate of crossover from aspiration thrombectomy before primary PCI to primary PCI only was 4.6%. There were no differences between the 2 treatment groups, either in the primary composite endpoint of cardiovascular death, recurrent MI, cardiogenic shock, or New York Heart Association class IV heart failure at 180 days, or in the individual components of the primary endpoint, stent thrombosis, or target-vessel revascularization. There was a small but statistically significant increase in the rate of stroke in the aspiration thrombectomy group. An updated meta-analysis that included these 3 trials among a total of 17 trials (n=20,960) found no significant reduction in death, reinfarction, or stent thrombosis with routine aspiration thrombectomy.

Aspiration thrombectomy was associated with a small but nonsignificant increase in the risk of stroke (33).

Several previous studies have found that higher thrombus burden in patients with STEMI is independently associated with higher risks of distal embolization, no-reflow phenomenon, transmural myocardial necrosis, major adverse cardiac events, stent thrombosis, and death (38-42). However, subgroup analyses from the TASTE and TOTAL trials did not suggest relative benefit from aspiration thrombectomy before primary PCI in patients with higher thrombus burden or in patients with initial Thrombolysis in Myocardial Infarction (TIMI) flow grade 0-1 or left anterior descending artery / anterior infarction (34,35).

On the basis of the results of these studies, the prior Class IIa recommendation for aspiration thrombectomy has been changed. *Routine* aspiration thrombectomy before primary PCI is now not recommended (Class III: No Benefit, LOE A). There are insufficient data to assess the potential benefit of a strategy of selective or bailout aspiration thrombectomy (Class IIb, LOE C-LD). “Bailout” aspiration thrombectomy is defined as thrombectomy that was initially unplanned but was later used during the procedure because of unsatisfactory initial result or procedural complication, analogous to the definition of “bailout” glycoprotein IIb/IIIa use.

It should be noted that the preceding recommendations and text apply only to aspiration thrombectomy; no clinical benefit for routine rheolytic thrombectomy has been demonstrated in patients with STEMI undergoing primary PCI (30,43,44).

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Key Words: AHA Scientific Statements, focused update, primary PCI, culprit vessel, multivessel, thrombectomy

Appendix 1. Author Relationships With Industry and Other Entities (Relevant)—2015 ACC/AHA/SCAI Focused Update on Primary Percutaneous Coronary Intervention for Patients With ST-Elevation Myocardial Infarction (Percutaneous Coronary Intervention Writing Committee)
(November 2014)

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This table represents the relationships of committee members with industry and other entities that were determined to be relevant to this document. These relationships were reviewed and updated in conjunction with all meetings and/or conference calls of the writing committee during the document development process. The table does not necessarily reflect relationships with industry at the time of publication. A person is deemed to have a significant interest in a business if the interest represents ownership of ≥5% of the voting stock or share of the business entity, or ownership of ≥$5,000 of the fair market value of the business entity; or if funds received by the person from the business entity exceed 5% of the person's gross income for the previous year. Relationships that exist with no financial benefit are also included for the purpose of transparency. Relationships in this table are modest unless otherwise noted.

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†No financial benefit.
‡Significant relationship.

ACC indicates American College of Cardiology; AHA, American Heart Association; and SCAI, Society for Cardiovascular Angiography and Interventions.

Appendix 2. Author Relationships With Industry and Other Entities (Relevant)—2015 ACC/AHA/SCAI Focused Update on Primary Percutaneous Coronary Intervention for Patients With ST-Elevation Myocardial Infarction (ST-Elevation Myocardial Infarction Writing Committee)
(February 2014)

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Frederick G. Kushner, Vice Chair	Tulane University School of Medicine—Clinical Professor of Medicine; Heart Clinic of Louisiana—Medical Director	None	None	None	None	None	None	None
Ralph G. Brindis	UCSF Philip R. Lee Institute for Health Policy Studies—Clinical Professor of Medicine	None	None	None	None	None	None	None
Donald E. Casey, Jr.	Thomas Jefferson College of Population Health—Adjunct Faculty; Alvarez & Marsal IPO4Health—Principal and Founder	None	None	None	None	None	None	None
Mina K. Chung	Cleveland Clinic Foundation—Professor of Medicine	• Boston Scientific‡ • Medtronic‡ • St. Jude‡	None	None	• Biosense Webster‡ • Boston Scientific‡ • Medtronic‡ • St. Jude†	None	None	2 and 3
James A. de Lemos	UT Southwestern Medical Center—Professor of Medicine	• Abbott Diagnostics • Novo Nordisc • St. Jude Medical	None	None	• Abbott Diagnostics†	None	None	2 and 3
Deborah B. Diercks	UT Southwestern Medical Center—Audre and Bernard Rapoport Distinguished Chair in Clinical Care and Research; Department of Emergency Medicine—	None	None	None	None	None	None	None

Committee Member	Employment	Consultant	Speakers Bureau	Ownership/ Partnership/ Principal	Personal Research	Institutional, Organizational or Other Financial Benefit	Expert Witness	Voting Recusals by Section*
	Professor and Chair							
James C. Fang	University of Utah—Cardiovascular Division	• Boston Scientific	None	None	None	None	None	2 and 3
Barry A. Franklin	William Beaumont Hospital—Director, Cardiac Rehabilitation and Exercise Laboratories	None	None	None	None	None	None	None
Christopher B. Granger	Duke Clinical Research Institute—Director, Cardiac Care Unit; Professor of Medicine	None	None	None	• Medtronic Foundation† • Merck†	None	None	2 and 3
Harlan M. Krumholz	Yale University School of Medicine—Professor of Epidemiology and Public Health	None	None	None	• Johnson & Johnson† • Medtronic†	None	None	2 and 3
Jane A. Linderbaum	Mayo Clinic—Assistant Professor of Medicine	None	None	None	None	None	None	None
David A. Morrow	Harvard Medical School—Professor of Medicine	• Abbott • Merck	None	None	• Abbott† • GlaxoSmith-Kline† • Johnson & Johnson† • Merck†	None	None	2 and 3
L. Kristin Newby	Duke University Medical Center, Division of Cardiology—Professor of Medicine	• Philips	None	None	• Merck†	None	None	2 and 3
Joseph P. Ornato	Department of Emergency Medicine Virginia Commonwealth University—Professor and Chairman	None	None	None	None	None	None	None
Narith Ou	Mayo Clinic—Pharmacotherapy Coordinator, Cardiology	None	None	None	None	None	None	None
Martha J. Radford	NYU Langone Medical Center—Chief Quality	None	None	None	None	None	None	None

Committee Member	Employment	Consultant	Speakers Bureau	Ownership/ Partnership/ Principal	Personal Research	Institutional, Organizational or Other Financial Benefit	Expert Witness	Voting Recusals by Section*
	Officer; NYU School of Medicine—Professor of Medicine (Cardiology)							
Jacqueline E. Tamis-Holland	Mount Sinai Saint Luke's Hospital and The Icahn School of Medicine—Program Director, Interventional Cardiology Fellowship Program	None	None	None	None	None	None	None
Carl L. Tommaso	Skokie Hospital—Director of Catheterization Laboratory; NorthShore University HealthSystems—Partner	None	None	None	None	None	None	None
Cynthia M. Tracy	George Washington University Medical Center—Associate Director, Division of Cardiology	None	None	None	None	None	None	None
Y. Joseph Woo	Stanford University—Professor and Chair, Cardiothoracic Surgery	None	None	None	None	None	None	None
David X. Zhao	Wake Forest Baptist Health—Professor of Medicine, Heart and Vascular Center of Excellence Director	None	None	None	• St. Jude‡ • Medtronic‡	None	None	2 and 3

This table represents the relationships of committee members with industry and other entities that were determined to be relevant to this document. These relationships were reviewed and updated in conjunction with all meetings and/or conference calls of the writing committee during the document development process. The table does not necessarily reflect relationships with industry at the time of publication. A person is deemed to have a significant interest in a business if the interest represents ownership of ≥5% of the voting stock or share of the business entity, or ownership of ≥$5,000 of the fair market value of the business entity; or if funds received by the person from the business entity exceed 5% of the person's gross income for the previous year. Relationships that exist with no financial benefit are also included for the purpose of transparency. Relationships in this table are modest unless otherwise noted.

According to the ACC/AHA, a person has a *relevant* relationship IF: a) the *relationship or interest* relates to the same or similar subject matter, intellectual property or asset, topic, or issue addressed in the *document*; or b) the *company/entity* (with whom the relationship exists) makes a drug, drug class, or device addressed in the *document*, or makes a competing drug or device addressed in the *document*; or c) the *person or a member of the person's household* has a reasonable potential for financial, professional, or other personal gain or loss as a result of the issues/content addressed in the *document*.

Dr. Deborah D. Ascheim was not eligible to continue on the writing committee due to her employment by Capricor Therapeutics effective August 2015.

*Writing group members are required to recuse themselves from voting on sections to which their specific relationships with industry and other entities may apply.
†Significant relationship.
‡No financial benefit.

ACC indicates American College of Cardiology; AHA, American Heart Association; NYU, New York University; UCSF, University of California San Francisco; and UT, Utah.

Appendix 3. Reviewer Relationships With Industry and Other Entities (Relevant)—2015 Focused Update on Primary Percutaneous Coronary Intervention for Patients With ST-Elevation Myocardial Infarction (Combined Peer Reviewers From 2011 PCI and 2013 STEMI Guidelines)

Reviewer	Representation	Employment	Consultant	Speakers Bureau	Ownership/ Partnership/ Principal	Personal Research	Institutional, Organizational or Other Financial Benefit	Expert Witness
Elliott M. Antman	Official Reviewer—AHA	Harvard Medical School—Professor of Medicine, Associate Dean for Clinical and Translational Research	None	None	None	None	None	None
Deepak L. Bhatt	Official Reviewer—AHA	Harvard Medical School—Professor; Interventional Cardiovascular Programs—Executive Director	None	None	None	• Bristol-Myers Squibb* • Ischemix* • Medtronic* • St. Jude Medical	• Regado Biosciences†	None
Christopher P. Cannon	Official Reviewer—AHA	Harvard Medical School—Professor of Medicine; Brigham and Women's Hospital—Senior Investigator, TIMI Study Group, Cardiovascular Division	• Bristol-Myers Squibb • Merck • Regeneron/ Sanofi-aventis*	None	None	• Merck*	None	None
Joaquin E. Cigarroa	Official Reviewer—ACC/AHA Task Force on Clinical Practice Guidelines	Oregon Health & Science University—Clinical Professor of Medicine	None	None	None	None	None	None
George Dangas	Official Reviewer—ACC Board of Trustees	Icahn School of Medicine—Professor of Cardiology and Vascular Surgery; Mount Sinai Medical Center—Director, Cardiovascular Innovation	• Abbott • Biosensors • Boston Scientific • Johnson & Johnson* • Merck • Osprey Medical*	None	None	None	• Abbott • Medtronic • Osprey	None

Reviewer	Representation	Employment	Consultant	Speakers Bureau	Ownership/ Partnership/ Principal	Personal Research	Institutional, Organizational or Other Financial Benefit	Expert Witness
			• Regado Biosciences					
Charles J. Davidson	Official Reviewer—SCAI	Northwestern University Feinberg School of Medicine—Professor of Medicine, Director of Cardiac Catheterization Lab	None	None	None	• Baxter International†	None	None
Kirk N. Garratt	Official Reviewer—SCAI	Hofstra University Medical School—Associate Chair of Quality and Research; Professor of Medicine	• Abbott • Boston Scientific • The Medicines Company • Daiichi-Sankyo/Eli Lilly • AstraZeneca	None	• LifeCuff Technologies • Global Delivery Systems	None	• Boston Scientific	None
Steven L. Goldberg	Official Reviewer—SCAI	University of Washington Medical Center—Cath Lab Director	• Terumo†	None	None	None	None	None
G. B. John Mancini	Official Reviewer—ACC Board of Governors	Vancouver Hospital Research Pavilion—Professor of Medicine	• Merck • Sanofi-aventis/ Regeneron	None	None	None	None	None
Jonathan M. Tobis	Official Reviewer—SCAI	University of California Los Angeles—Professor of Medicine and Cardiology	• St. Jude Medical	None	None	None	None	None
Jeffrey L. Anderson	Content Reviewer—ACC/AHA Task Force on Clinical Practice Guidelines	Intermountain Medical Center—Associate Chief of Cardiology	None	None	None	None	None	None
Thomas M. Bashore	Content Reviewer	Duke University—Professor of Medicine	None	None	None	None	None	None
James A. Burke	Content Reviewer—ACC	Lehigh Valley Heart Specialists—Associate	None	None	None	None	None	None

Reviewer	Representation	Employment	Consultant	Speakers Bureau	Ownership/ Partnership/ Principal	Personal Research	Institutional, Organizational or Other Financial Benefit	Expert Witness
	Interventional Scientific Council	Chief, Division of Cardiology						
Jeffrey J. Cavendish	Content Reviewer—ACC Prevention of Cardiovascular Disease Committee	Kaiser Permanente Cardiology—Interventional Cardiologist	None	None	None	None	• Abbott	None
Gregory J. Dehmer	Content Reviewer—ACC Appropriate Use Criteria	Texas A&M College of Medicine—Professor of Medicine; Scott & White Healthcare	None	None	None	None	None	None
John S. Douglas, Jr.	Content Reviewer	Emory University Hospital—Professor of Medicine	None	None	None	• Abbott • Medtronic	None	None
John P. Erwin III	Content Reviewer—ACC/AHA Task Force on Performance Measures	Texas A&M College of Medicine—Associate Professor; Scott & White Healthcare—Vice-Chair of the Department of Medicine	None	None	None	None	None	None
T. Bruce Ferguson	Content Reviewer—ACC Surgeons' Scientific Council	East Carolina Institute Brody School of Medicine—Professor of Surgery and Physiology	None	None	None	None	None	None
Anthony Gershlick	Content Reviewer	University Hospitals of Leicester, Department of Cardiology	• Abbott • Boston Scientific • Cordis • Medtronic	• Abbott†	None	None	None	None
Jonathan L. Halperin	Content Reviewer—ACC/AHA Task Force on Clinical	Mt. Sinai Medical—Professor of Medicine	• Bayer Healthcare • Boston Scientific	None	None	None	None	None

Reviewer	Representation	Employment	Consultant	Speakers Bureau	Ownership/ Partnership/ Principal	Personal Research	Institutional, Organizational or Other Financial Benefit	Expert Witness
	Practice Guidelines		• Johnson & Johnson • Medtronic					
Howard C. Herrmann	Content Reviewer	University of Pennsylvania Perelman School of Medicine—Professor of Medicine, Director of Interventional Cardiology Program	• Seimens Medical • St. Jude Medical	None	None	• Abbott* • Medtronic • Siemens Medical* • St. Jude Medical	None	None
Morton J. Kern	Content Reviewer	University of California Irvine—Professor of Medicine, Associate Chief of the Division of Cardiology	• Acist Medical • Merit Medical*	• St. Jude Medical*	None	None	None	None
Fred M. Kosumoto	Content Reviewer	Mayo Clinic—Director, Pacing and Electrophysiology Service	None	None	None	None	None	None
David J. Maron	Content Reviewer	Stanford University School of Medicine—Professor of Medicine and Emergency Medicine	None	None	None	None	None	None
Douglass A. Morrison	Content Reviewer	University of Arizona—Professor of Medicine; Southern Arizona VA Health Care System—Cardiac Catheterization Laboratories, Director	None	None	None	None	None	None
Manesh R. Patel	Content Reviewer—ACC Appropriate Use Criteria	Duke University Medical Center—Associate Professor of Medicine	• Bayer Healthcare* • Janssen Pharmaceuticals*	None	None	• Johnson & Johnson*	None	None
M. Eugene Sherman	Content Reviewer—ACC Board of Governors	Aurora Denver Cardiology	None	None	None	None	• Bristol-Myers Squibb* • Hospira*	None

Reviewer	Representation	Employment	Consultant	Speakers Bureau	Ownership/ Partnership/ Principal	Personal Research	Institutional, Organizational or Other Financial Benefit	Expert Witness
Daniel I. Simon	Content Reviewer	University Hospitals Case Medical Center—Professor of Cardiovascular Research	• Cordis/Johnson & Johnson* • Janssen Pharmaceuticals/Johnson & Johnson • Medtronic Vascular • Merck	• Abbott	None	None	None	None
Richard W. Snyder	Content Reviewer—ACC Board of Governors	HeartPlace	None	None	None	None	None	None
William A. Tansey III	Content Reviewer	Summit Medical Group—Cardiologist	None	None	None	None	None	None
David D. Waters	Content Reviewer	San Francisco General Hospital—Chief, Division of Cardiology	None	None	None	None	• Merck	None
Patrick L. Whitlow	Content Reviewer	Cleveland Clinic Foundation—Director, Interventional Cardiology	None	None	None	• Abbott	• Medtronic*	
David O. Williams	Content Reviewer	Harvard Medical School—Professor of Medicine; Brigham and Women's Hospital	None	None	None	None	None	None
Clyde W. Yancy	Content Reviewer—ACC/AHA Task Force on Practice Guidelines	Northwestern University Feinberg School of Medicine—Vice Dean for Diversity and Inclusion, Chief of Medicine-Cardiology, Professor	None	None	None	None	None	None
Yerem Yeghiazarians	Content Reviewer	University of California San Francisco—Associate Professor	None	None	None	None	None	None

This table represents the relationships of reviewers with industry and other entities that were disclosed at the time of peer review and determined to be relevant to this document. It does not necessarily reflect relationships with industry at the time of publication. A person is deemed to have a significant interest in a business if the interest represents ownership of ≥5% of the voting stock or share of the business entity, or ownership of ≥$5,000 of the fair market value of the business entity; or if funds received by the person from the business entity exceed 5% of the person's gross income for the previous year. A relationship is considered to be modest if it is less than significant under the preceding definition. Relationships that exist with no financial benefit are also included for the purpose of transparency. Relationships in this table are modest unless otherwise noted. Names are listed in alphabetical order within each category of review.

According to the ACC/AHA, a person has a *relevant* relationship IF: a) the *relationship or interest* relates to the same or similar subject matter, intellectual property or asset, topic, or issue addressed in the *document*; or b) the *company/entity* (with whom the relationship exists) makes a drug, drug class, or device addressed in the *document*, or makes a competing drug or device addressed in the *document*; or c) the *person or a member of the person's household* has a reasonable potential for financial, professional, or other personal gain or loss as a result of the issues/content addressed in the *document***.**

*Significant relationship.
†No financial benefit.

ACC indicates American College of Cardiology; AHA, American Heart Association; HF, heart failure; SCAI, Society for Cardiovascular Angiography and Interventions; STEMI, ST-elevation myocardial infarction; PCI, percutaneous coronary interventions; TIMI, Thrombolysis In Myocardial Infarction; and VA, Veteran's Affairs.

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Circulation. published online October 21, 2015;
Circulation is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231

Print ISSN: 0009-7322. Online ISSN: 1524-4539

Data Supplements: 2015 Focused Update on Primary PCI for Patients With STEMI

Data Supplement 1-A. Observational Studies Comparing Culprit Artery-Only Revascularization Versus Multivessel PCI (Section 2)

Study Acronym Author Year	Aim of Study; Study Type; Study Size (N)	Patient Population	Primary Endpoint and Results	Relevant 2° Endpoint (if any); Study Limitations; Adverse Events and Summary
Iqbal MB, et al., 2014 (1) 25371542	Aim: To investigate mortality for COR vs. MV PCI at the time of PPCI for patients presenting with STEMI Study type: Observational. Used multivariate analysis and propensity matching Size: 3984 (MV PCI at time of PPCI=555; COR=3429)	Inclusion criteria: • STEMI and PPCI • MVD defined as >50% stenosis in ≥2 epicardial coronary arteries Exclusion criteria: • LM >50% stenosis • Cardiogenic shock	1° endpoint: 1-y mortality • Total study population: 7.4% (COR) vs.10.1% (MV) (p=0.031) • Adjusted HR Total population: 0.65 (95% CI: 0.47-0.91; p=0.011) • Propensity matched cohort: 164/2418 (6.8%) vs. 41/403 (10.2%) , p=0.059 • Adjusted propensity matched cohort HR: 0.64 (95% CI: 0.45-0.90; p=0.010)	• Inverse probability treatment weighted analyses also confirmed COR as an independent predictor for reduced in-hospital MACE (odds ratio, 0.38; 95% CI, 0.15–0.96; p=0.040) and survival at 1 year (hazard ratio, 0.44; 95% CI, 0.21–0.93; p=0.033).
Santos AR, et al., 2014 (2) 24502933	Aim: To assess the impact of a MV PCI at the time of PPCI on in-hospital morbidity and mortality in patients with STEMI undergoing PPCI Study type: Observational: Portuguese Society of Cardiology's Registry of Acute Coronary Syndromes (ACS) Size: 257 (MV PCI at time of PPCI 77 vs. COR 180)	Inclusion criteria: • STEMI • Enrolled in Portuguese Society of Cardiology Registry • MVD defined as ≥50% Exclusion criteria: • Staged MV PCI • History of prior CABG	1° endpoint : In-hospital mortality COR vs. MV PCI at time of PPCI: • In-hospital Mortality: 14/180 (7.8%) vs. 2/77 (2.6%), p=NS • Adjusted mortality OR: 12.92, 95% CI 0.67-248.4, p=0.09	
Jeger R, et al., 2014 (3) 24461983	Aim: To assess whether MV PCI at time of PPCI vs. COR in patients with STEMI and MVD influences 1-y outcome Study type: Observational: Swiss Nationwide Acute Myocardial Infarction in Switzerland Plus Registry (AMIS)	Inclusion criteria: • STEMI or new LBBB • MVD defined as a ≥50% in ≥2 different major epicardial coronary arteries and/or involving the LM. • Written informed consent to enroll	1° endpoint: 1-y all-cause mortality MV PCI 12/442 (2.7%) vs COR: 40/1467 (2.7%), p>0.99	• MACCE at 1 y (all-cause death, re-MI, any cardiac re- intervention, re-hospitalization due to any cardiovascular diagnosis, and CVA): Adjusted OR for MV PCI vs COR=0.69, 95% CI 0.51–0.93, p=0.017

	Size: 1909 (MV PCI at time of PPCI 442 vs. COR 1467)	in registry. Exclusion criteria: • Absence of follow-up data		
Manari A, et al., 2014 (4) 24403174	Aim: To examine the differences in cardiac outcomes for patients with STEMI and MVD as a function of whether they underwent COR or MV PCI, either at the time of PPCI or as a staged procedure. Study type: Observational retrospective: REAL registry Size: 2061 (MV PCI at time of PPCI 367, Staged MV PCI within 60 d 988, COR 706)	Inclusion criteria: • STEMI and MVD enrolled in REAL registry Exclusion criteria: • N/A	1° endpoint: Mortality at 30 d and 2 y COR vs. staged MV PCI • 30-d mortality: adjusted HR: 2.81 (95% CI: 1.34-5.89; p=0.006) • 2-y mortality: adjusted HR: 1.93 (95% CI: 1.35-2.74; p=0.0002) MV PCI at time of PPCI vs. staged MV PCI: • 30-d mortality adjusted HR: 2.58 (95 % CI: 1.06-6.26; p=0.03) • 2-y adjusted HR: 1.08 (95% CI: 0.64-1.82; p=0.76) COR vs. MV PCI at time of PPCI • 2-y unadjusted mortality:127/706 (18.0%) vs. 26/367 (7.1%), p=0.0002	• Study looked at timing of MV PCI and showed that staged MV PCI was associated with better outcomes than either COR or MV PCI at the time of PPCI
Jaguszewski M, et al., 2013 (5) 24384288	Aim: To compare the outcomes with MV PCI at the time of PPCI with COR Study type: Observational: Swiss Nationwide Acute Myocardial Infarction in Switzerland Plus Registry (AMIS) Size: 4941 (MV PCI at time of PPCI-1108 vs. COR-3833)	Inclusion criteria: • STEMI • MVD: stenosis ≥50% in at least two of three major coronary arteries and/or involving the LM (in pts with prior CABG) Exclusion criteria: • N/A	1° endpoint: In-hospital mortality MV PCI at time of PPCI vs. COR: • 81/1108 (7.3%) vs. 168/3833 (4.4%), p<0.001 • Low risk pts: 2.0% vs.2.0% (p=1.00) • High risk pts: 22.2% vs. 21.7% (p=1.00)	
Bauer T, et al., 2013 (6) 22192297	Aim: To evaluate the impact of MV-PCI during a single procedure on in-hospital outcomes of patients with MVD presenting with ACS Study type: Observational: Euro Heart Survey Registry with STEMI Size: 2537 (MV PCI during a single procedure 419 vs. COR 2118)	Inclusion criteria: • Hemodynamically stable patients with ACS • MVD defined as ≥2 vessels with ≥70% stenosis • Undergoing PCI Exclusion criteria: • N/A	1° endpoint: In-hospital mortality MV PCI during single procedure vs. COR: • 6/419 (1.4%) vs. 72/2118 (3.4%), p=0.03 • In-hospital mortality adjusted OR: 0.48 (95% CI: 0.21-1.13; p=0.73)	• Non-fatal MI: higher with MV PCI (8.8% vs.1.6%, p<0.0001)
Dziewierz A, et al., 2010 (7) 20643243	Aim: To assess the impact of MV PCI at time of PPCI vs COR in pts with STEMI and MVD Study type: Observational: Euro-Transfer Registry	Inclusion criteria: • Patients with STEMI included in Euro-transfer registry • MVD on cath Exclusion criteria: • N/A	1° endpoint: 1-y mortality MV PCI at time of PPCI vs. COR • 11/70 (15.7%) vs. 57/707 (8.1%), p=0.043 • Adjusted OR: 2.04 (95% CI: 0.89–4.66; p=0.09)	• 30-d mortality: 12.9% vs.5.9% (p=0.039) • Adjusted 30-d mortality: OR: 2.42 (95% CI: 0.96-6.06; p=0.06)

	Size: 777(MV PCI at time of PPCI 70 vs. COR 707)			
APEX-AMI Toma M, et al., 2010 (8) 20530505	Aim: To evaluate the 90-d outcomes for MV PCI performed at the time of PPCI Study type: Observational: APEX AMI Size: 2201(MV PCI at time of PPCI 217 vs. COR 1984)	Inclusion criteria: • ≥18 y • Ischemic symptoms <6 h • STEMI undergoing PPCI • MVD with ≥70% stenosis of another major epicardial vessel and/or requiring PCI Exclusion criteria: • PCI following lytics • Limited IWMI • LM PCI	1° endpoint: 90-d mortality and composite of death, CHF, and cardiogenic shock MV PCI at time of PPCI vs. COR: • 90-d mortality: 27/217 (12.4%) vs. 111/1984 (5.6%) , p<0.001; Adjusted HR: 2.44, 95% CI 1.55–3.83, P <0.001 • Unadjusted 90-d death/CHF/shock 18.9% vs.13.1% (p=0.011); Adjusted HR 1.39 (95% CI: 0.96-2.01; p=0.083)	• Limited inclusion of only STEMI pts that met the APEX-AMI trial criteria.
Hannan EL, et al., 2010 (9) 20129564	Aim: To examine the differences in in-hospital and longer-term mortality for patients with STEMI and MVD as a function of whether they underwent COR or MV PCI, either at the time of PPCI or as a staged procedure Study type: Observational; NY State Registry Size: 4,024 (MV PCI at time of PPCI=503; Staged MV PCI =259; COR=3,521)	Inclusion criteria: • STEMI within 24 h undergoing PPCI • MVD • NY State resident Exclusion criteria: • Missing data on EF • Thrombolytic therapy • Shock • Prior CABG	1° endpoint: In hospital, 12-, 24-, and 42-mo mortality For MV PCI at time of PPCI vs. COR: • In-hospital mortality: 3.4% vs.2.0% (p=0.14) • 12-mo mortality: 7.1% vs.5.5%, (p=0.23) • 24-mo mortality: 8.6% vs.6.6% (p=0.17) • 42-mo mortality: 11.7% vs. 10.7% (p=0.23) • Propensity matched 42-mo mortality: 59/503 vs. 54/503 Staged MV PCI during index admission vs. COR: • In-hospital mortality: 1.2% vs.1.9% (p=0.48) • 12-mo mortality: 3.9% vs.5.5% (p=0.53) • 24-mo mortality: 6.3% vs.7.4% (p=0.71) • 42-mo mortality: 6.3% vs.8.4% (p=0.72) For Staged MV PCI within 60 d vs. COR: • 12-mo mortality:1.3% vs.3.3% (p=0.04) • 24-mo mortality: 3.7% vs.4.3% (p=0.21) • 42-mo mortality: 5.6% vs.7.4% (p=0.17)	• Used propensity matched data to evaluate the outcome of MV PCI at various time points compared with COR. • Of note, for the subgroup of patients without shock, low EF or arrhythmias, MV PCI at the time of PPCI as compared with COR resulted in a higher in hospital mortality (2.4% vs.0.9%,p=0.04) and trends toward higher 24-mo (7.2% vs.4.9%, p=0.07) and 42-mo (10.4% vs.6.7%, p=0.08) mortality
Cavender MA et al.,	Aim: To examine the outcomes of patients	Inclusion criteria:	1° endpoint: In-hospital mortality.	• Bleeding (non-shock patients): 6.71%

2009 (10) 19660603	with STEMI undergoing MV PCI at time of PPCI vs. patients undergoing COR Study type: Observational: NCDR Registry Size: 28,936 (MV PCI at time of PPCI 3,134 vs. COR 25,802)	• STEMI treated with PPCI • ≥1 additional major artery with significant stenosis. Exclusion criteria: • PCI of LM • Staged PCI in hospital • Recent thrombolytics	MV PCI at time of PPCI vs. COR: • In hospital mortality: 246/3134 (7.85%) vs. 1321/25802 (5.12%), p<0.01 • Patients without shock: 3.26% vs.2.53% (p=0.09); Adjusted mortality: OR=1.23 (95% CI: 0.94-1.61; p=1.23) • Patients with shock: 36.49% vs.27.77% (p≤0.01); Adjusted mortality: OR=1.54 (95% CI: 1.22-1.95; p<0.01)	(MV at time of PPCI) vs.5.30% (COR), p<0.01 • Trend towards more renal failure with MV PCI at time of PPCI 2.31% vs.1.81% (p=0.09) • Very large registry also analyzed outcomes according to presence or absence of shock.
Varani E, et al., 2008 (11) 18798239	Aim: To examine a strategy of COR vs.MV-PCI on clinical outcomes in a cohort of patients with STEMI treated with PPCI and compare the outcomes of MVD patients according to the type of revascularization (MV PCI at the time of PPCI vs. staged MV PCI vs. COR) Study type: Observational: single center Size: Total=399. MV PCI before discharge 243 (divided into groups: MV PCI at time of PPCI= 147; MV PCI within 24 h =48; and MV PCI after 24 h but before before discharge=48); COR=156	Inclusion criteria: • Ongoing symptoms within 24 h • STEMI • MVD (≥2 major epicardial coronary arteries or their major branches with stenosis ≥70%) Exclusion criteria: • PCI for acute occlusion after angiography	Endpoints: Death from any cause and any revascularization. Time point not specified. In-hospital mortality for COR vs. MV PCI at time of PPCI: 8/156 (5.1%) vs. 12/147 (8.2%), p<0.05 COR vs. MV PCI at time of PPCI vs. MV PCI within 24 h vs. MV PCI before discharge • 6.6% vs. 9.9% vs. 2.1% vs. 2.1% (p=0.066 for overall comparison) • excluding pts with shock or CHF: 6.3% vs.3.3% vs.2.1% vs.2.1% (p=0.257)	Complete revascularization in 46% of patients with MVD
Qarawani D, et al., 2008 (12) 17428557	Aim: To compare outcomes with two strategies used for treating MVD and acute MI Study type: Observational: Single center Size: 120 (MV PCI at time of PPCI 95 vs. COR 25)	Inclusion criteria: • Prolonged >30 min ischemic chest pain • Symptom onset <12 h • STEMI • MVD defined as >70% stenosis of ≥1 additional coronary artery Exclusion criteria: • Cardiogenic shock • LM ≥50%	1° endpoint: In-hospital MACE (re-ischemia, re-MI, acute CHF and mortality) MV PCI vs. COR: • 16.7% vs. 52%, p=0.0001. • Adjusted OR for In-hospital MACE:14.68, 95% CI: 3.03–71.12, p=0.001	• In-hospital mortality: 4.2% vs.4.0%, p=NS • 1-year mortality for MV PCI vs. COR: 9/95 (9.5%) vs. 2/25 (8.0%), p=0.06 • MV PCI associated with improved hospital survival when compared with COR even after adjusting for other factors • MV PCI had higher rates of transient renal failure (8.4% vs.4.0%, p=0.01) and trend toward higher 1-y mortality (9.4% vs.8.0%, p=0.06)
Corpus RA, et al., 2004 (13) 15389238	Aim: To compare outcomes between an aggressive MV PCI strategy either at time of PPCI or before hospital discharge and COR Study type: Observational: Single Center Size: 506 (MV PCI 152 [Divided into 2 groups: MV PCI at the time of PPCI=26; staged in hospital PCI=126] vs.	Inclusion criteria: • STEMI • Symptom onset ≤ 12 h • MVD defined as ≥70% stenosis of ≥2 epicardial coronary arteries or their major branches Exclusion criteria: • PCI of vein graft or LM	1° endpoint: Numerous endpoints at 1 year MV PCI (either at time of PPCI or staged) vs COR: Death 11% vs 12 %, p=0.82 Re-infarction: 13.0% vs 2.8%, p<0.001 Revascularization: 25% vs 15%, p=0.007 MACE: 40% vs 28%, p=0.006	• Multivessel PCI was an independent predictor of MACE at 1 year (odds ratio=1.67, 95% CI 1.10-2.54, p=01).

	COR 354)	• PCI for acute occlusion after coronary angioplasty or arteriography; • MVD and staged revascularization procedures of the non-IRA after discharge from the hospital.	1-yr mortality MV PCI at time of PPCI vs staged MV PCI vs COR: 5/26 (19.2%) vs. 12/126 (9.5%) vs. 42/354 (11.9%), p=0.36	
Roe MT, et al., 2001 (14) 11448417	Aim: To determine the feasibility and safety of MV PCI at the time of PPCI Study type: Case Controlled Size: 158 (MV PCI at the time of PPCI 79 [Divided into 2 Groups: MV PCI at time of PPCI=68; Rescue PCI=11] vs. COR 79 ([PPCI 61,Rescue PCI=18])	Inclusion Criteria: • Patients with AMI undergoing PCI • ≥1 coronary stenosis ≥50% in a non-culprit vessel) Exclusion criteria: • PCI of branch vessels of IRA • PCI of LM	1° endpoint: Death, re-MI, repeat PCI or CABG at 6 mo MV PCI at time of PPCI vs. COR: 35.3% vs 27.9% p=NS	• Study found higher mortality for MV PCI vs. COR in the primary PCI group at 30 d but no difference in events at 6 mo • Study involved a mix of POBA and stents • 6-mo mortality for MV PCI at time of PPCI vs. COR: 19/79 (24.1%) vs.13/79 (16.1%), p=NS

Data Supplement 1-B. RCTs Comparing Culprit Artery-Only Revascularization Versus Multivessel PCI (Section 2)

Study Acronym Author Year	Aim of Study; Study Type; Study Size (N)	Patient Population	Study Intervention	Primary Endpoint and Results	Relevant 2° Endpoint (if any); Study Limitations; Adverse Events and Summary
DANAMI 3-PRIMULTI Engstrom T, et al., 2015 (15) (Not yet in PubMed)	Aim: To determine whether staged angiographic or FFR guided revasc in STEMI patients with MVD reduces the primary endpoint of all cause death, reinfarction and repeat revascularisation compared with COR Study type: Randomized Size: 627 (314 staged MV PCI; 313 COR)	Inclusion criteria: • STEMI ≤12 h • Successful IRA PPCI • >50% stenosis >2mm in non-IRA suitable for PCI Exclusion criteria: • Hemodynamic instability or ischemia in non IRA territory • CTO of non-IRA	Intervention: Complete in-hospital revasc with staged MV PCI for lesions >90% and staged FFR-guided MV PCI for lesions of 50- 90% severity(n=314) Comparator: COR (n=313)	1° endpoint: MACE at 12 mo (Death, MI, ischemia-driven revasc of non-IRA lesions) MV PCI vs. COR • 40/314 (13%) patients treated with staged MV PCI vs 68 of 313 (22%) patients treated with COR, p=0.004; (HR 0.56, 95% CI 0.38-0.83, p=0.001)	• 12-mo mortality: 15/314 (5%) vs. 11/313 (4%) • This study used FFR guidance for lesions of 50%-90% severity. • Benefit was driven by a significant reduction in ischemia-driven revascularization; death and MI rates were similar
CvLPRIT Gershlick AH, et al., 2015 (16) 25766941	Aim: To compare differences in outcome for patients with STEMI and MVD randomized to MV PCI or COR Study type: Randomized Size: 296 (MV PCI=150; COR=146)	Inclusion criteria: • STEMI <12 h • Referred for PPCI • MVD on cath with ≥1vessel >2mm in diameter with >70% stenosis in 1 plane or >50% stenosis in 2 planes • Non IRA suitable for stent implantation	Intervention: MV PCI either at time of PPCI or as a staged in-hospital procedure (n=150) Comparator: COR (n=146)	1° endpoint: Composite of death, re-MI, CHF and ischemia- driven revasc at 12 mo MV PCI vs. COR 10.0% vs.21.2% (HR: 0.45; 95% CI: 0.24-0.84; p=0.009)	• 65% of pts underwent MV PCI at time of PPCI • Benefit was driven by sum of individual endpoints; no statistically significant difference in outcome in individual components of primary endpoint • Total 12-mo mortality: 4/150 (2.7%) vs. 10/146 (6.9%) (HR: 0.38; 95% CI: 0.12- 1.20; p=0.09

		Exclusion criteria: • Indication for or contraindication to complete revasc • Prior Q wave MI • Prior CABG • Shock, VSD or Moderate to severe mitral regurgitation • Chronic kidney disease • Stent thrombosis • CTO of the only non-IRA			
PRAMI Wald DS, et al., 2013 (17) 23991625	Aim: To compare the outcomes of MV PCI at the time of PPCI with COR and an ischemia guided approach to non-culprit artery disease. Study type: Randomized Size: 465 (234 MV PCI at time of PPCI; 231 COR)	Inclusion criteria: • Acute STEMI (incl LBBB) • Successful PPCI • MVD with ≥50% stenosis in ≥1 other artery suitable for PCI Exclusion criteria: • Shock, • Prior CABG, • LM or ostia of both LAD and circumflex with >50% stenosis • CTO of non-IRA	Intervention: MV PCI at the time of PPCI (n=234) Comparator: COR with ischemia guided approach to non-culprit artery disease (n=231)	1° endpoint: MACE: (death from cardiac causes, nonfatal MI, or refractory angina). Results assessed after mean f/u of 23 mo MV PCI at the time of PPCI vs. COR • 9.0% vs.22.9%, (HR 0.35, 95% CI 0.21–0.58, <0.001)	• Trial stopped early by DSMB • HR for components of primary endpoint (MV PCI vs PPCI only): o Death from cardiac causes: 0.34 (95% CI, 0.11 to 1.08) o Non-fatal MI: 0.32 (95% CI, 0.13 to 0.75) o Refractory angina: 0.35 (95% CI, 0.18 to 0.69) o All-cause mortality: 12/234 (5.1%) vs 16/231 (6.9%), p=NS
Dambrink JH, et al., 2010 (18) 20542783	Aim: To compare effect of early invasive FFR guided management vs. COR and ischemia-guided management on LV EF Study type: Randomized Size: 121 (FFR-guided MV PCI 80; COR 41)	Inclusion criteria: • STEMI patients undergoing successful PPCI • MVD • with ≥1 additional major artery or branch • with ≥50 % disease and at least 2.5 mm diameter Exclusion criteria: • Urgent indication for additional revasc • >80 y • CTO of non IRA • Prior CABG • LM ≥50 %, • Restenotic • lesions in non-IRA • Chronic atrial fibrillation, • Limited life expectancy • Other factors that made complete follow-up unlikely.	Intervention: PPCI and elective (within 3 wk) FFR guided management of non IRA disease (n=80) Comparator: COR with conservative ischemia- guided management of non IRA (n=41)	1° endpoint: EF at 6 mo FFR guided staged PCI vs. COR and ischemia-guided approach: EF 59± 9% vs. 57± 9%, p=0.362	• MACE at 6 mo: 21% vs. 22%, p=0.929 • MACE at 3 years: 35.4% vs 35.0%, p=0.96 • Death or MI at 3 years: 20.3% vs 0%, p=0.002 • Death at 3 years: 2/80 vs. 0/41

Politi L, et al., 2010 (19) 19778920	Aim: To compare long-term outcomes of three different strategies during PPCI in patients with STEMI and MVD: COR vs. staged MV PCI vs. MV PCI at the time of PPCI Study type: Randomized Size: 214 (65 MV PCI at time of PPCI; 65 staged MV PCI; 84 COR)	Inclusion criteria: • Chest pain within 12 h • STEMI Exclusion criteria: • Cardiogenic shock • LM ≥50% • Prior CABG • Severe valvular heart disease • Unsuccessful PPCI	Intervention: PPCI plus staged MV PCI: 65; MV PCI at the time of PPCI (n=65) Comparator: COR (n=84)	1° endpoint: MACE at mean f/u 2.5 y: (death, re-MI, re-hospitalization for ACS and repeat coronary revasc) MV PCI at the time of PPCI vs. staged MV PCI vs. COR: • 23.1% vs.20% vs.50% p<0.001 • Adjusted HR for MACE for MV PCI at the time of PPCI vs COR: 0.495, 95% CI 0.262 to 0.933, p=0.030 • Adjusted HR for MACE for Staged MV PCI vs COR: 0.377, 95% CI 0.194 to 0.732 p=0.004	• There were no differences in outcomes for staged MV PCI vs. MV PCI at time of PPCI but small number of enrolled patients • Mortality for MV PCI vs COR: 10/130 (7.7%) vs.13/84 (15.5%),
HELP-AMI, et al., Di Mario C, et al., 2004 (20) 16146905	Aim: To evaluate the efficacy of a complete revascularization strategy at the time of PPCI on reducing repeat revascularizations in follow-up Study type: Randomized Size: 69 (MV PCI at time of PPCI 52; COR 17)	Inclusion criteria: • Ischemic CP and STEMI • MVD on angiogram technically amenable to PCI Exclusion criteria: • Lesion in bypass grafts • Prior PCI or stent in segment with disease • Thrombolysis within past wk; • Shock • LM disease • Intention to treat more than 1 lesion • Calcified or tortuous vessels with lesions; side branch >2 mm	Intervention: MV PCI at time of PPCI (n=52) Comparator: COR then PCI of other vessels at operators discretion (n=17)	1° endpoint: Any repeat revasc at 1 y MV PCI at time of PPCI vs. COR: 17.3% vs.35.3%, p=0.174	• Very small study; Unbalanced randomization • 12-mo mortality: 1/52 (1.9%) vs. 0/17 (0%), p=0.754

ACS indicates acute coronary syndrome; AMI, acute myocardial infarction; BRAVE-2, Beyond 12 hours Reperfusion Alternative Evaluation trial; C, coronary; CAD, coronary artery disease; Cath, catheterization; CHF, congestive heart failure; CI, confidence interval; Contra, contraindications; COR, culprit artery-only (or infarct related artery-only) PCI; CR, complete revascularizations; CTO, chronic total occlusion; CV, cardiovascular; CVA, stroke; EF, ejection fraction; FFR, Fractional Flow Reserve; f/u, follow up; Fx, fibrinolysis; gp, group; HR, hazard ratio; IR, incomplete revascularization; IRA, infarct related artery; LAD, left anterior descending artery; LBBB, left bundle branch block; LM, left main; LV, left ventricle; MACE, major adverse cardiac events; MI, myocardial infarction; MVD; multivessel disease; MV PCI, multivessel PCI; NY, New York; Occ, occlusion; OR, odds ratio; PA, pulmonary artery; PCI, percutaneous coronary intervention; PCWP, pulmonary-capillary wedge pressure; POBA, balloon angioplasty; PPCI, primary PCI; pts., patients; RCT, randomized control trial; re-MI, recurrent MI; RCT; randomized controlled trial; revasc, revascularization; RR, relative risk; SK, streptokinase; SPECT, single-photon emission computed tomography; STE, ST elevation; STEMI, ST elevation myocardial infarction; sx, symptoms; THC, thrombocytopenia; TIA, transient ischemic attack; TIMI, thrombolysis in myocardial infarction; tPA, tissue plasminogen activator; TVR, target vessel revascularization; tx, treatment; and VSD, ventricular septal defect.

Data Supplement 2. RCTs for Aspiration Thrombectomy (Section 3)

Study Acronym Author Year	Aim of Study; Study Type; Study Size (N)	Patient Population	Study Intervention	Primary Endpoint and Results	Relevant 2° Endpoint (if any); Study Limitations; Adverse Events and Summary
TOTAL Jolly SS, et al., 2015 (21) 25853743	Aim: To assess whether thrombus aspiration reduces MACE in patients with STEMI Study type: Randomized Size: 10,732 (thrombectomy 5372, PCI alone 5360);	Inclusion criteria: • Symptoms of myocardial ischemia lasting for ≥ 30 min • Definite ECG changes indicating STEMI • Patients referred for primary PCI • Randomized within 12 h of symptom onset and prior to diagnostic angiography Exclusion criteria: • Prior CABG • Life expectancy <6 mo due to non-cardiac condition • Treatment with fibrinolytic therapy for qualifying index STEMI event	Intervention: Thrombus aspiration before PCI (5033) Comparator: PCI alone (5030)	1° endpoint: Composite of CV death, re-MI, cardiogenic shock, NYHA heart failure within 180 d Thrombectomy vs PCI alone: 6.9% vs. 7.0% (HR: 0.99; 95% CI: 0.85-1.15; p=0.86)	• Safety endpoint: Stroke within 30 d: thrombectomy 0.7% vs. 0.3% PCI alone (HR: 2.06; 95% CI: 1.13-3.75; p=0.02) • CV death: thombectomy 3.1% vs. 3.5% PCI alone (HR: 0.90; 95% CI 0.73-1.12; p=0.34). • Primary outcome + stent thrombosis +TVR: thrombectomy 9.9% vs. 9.8% PCI alone, (HR: 1.00; 95% CI: 0.89-1.14; p=0.95). Summary: • No group differences with respect to re-MI, shock, NYHA heart failure, stent thrombosis, TVR, major bleeding, net clinical benefit (primary efficacy outcome or stroke). • No differences in rate of primary outcome in pre-specified subgroups, including extent of thrombus burden. • Improved ST resolution and lower rates of distal embolization with thrombectomy • Bailout thrombectomy rate 7.1% among patients randomized to PCI alone. • No or possible thrombus present (TIMI thrombus grade 0-1) in 6.7% thrombectomy patients, 8.1% PCI-alone patients.

TASTE
Lagerqvist B, et al., 2014 (22)
25176395
	Aim: To assess if thrombus aspiration reduces mortality in STEMI pts at 1 y in the TASTE study
	
	Study type: Randomized
	
	Size: 7244 (3621 thrombectomy, 3623 PCI alone)
		Inclusion criteria:
		• Chest pain, at least for 30 min, onset of sx to admission <24 h
		• STEMI or LBBB
		
		Exclusion criteria:
		• Need for CABG
		• Previous randomization in TASTE trial
			Intervention: Thrombus aspiration before PCI (3621)
			
			Comparator: PCI only (3623)
				1° endpoint: N/A (previously reported in TASTE)	• Events at 1 year f/u:
					  • Death from any cause 5.3% vs. 5.6% (HR: 0.94; 95% CI: 0.78-1.15; p=0.57),
					  • Rehospitalization for MI 2.7% vs. 2.7% (HR: 0.97; 95% CI: 0.73-1.28; p=0.81), stent thrombosis 0.7% vs. 0.9% (HR: 0.84; 95% CI: 0.50-1.40; p=0.51)
					  • Incidence of composite of death, rehospitalization for MI, or stent thrombosis: 8.0% v. 8.5% (HR: 0.94; 95% CI: 0.8-1.11; p=0.48).
					• Outcome events were recorded on the

					basis of registry data and were not systematically adjudicated (ascertainment of outcome events may have been less accurate than a RCT). Results cannot necessarily be extrapolated to very high-risk pts who would not have been eligible for inclusion.
TASTE Frobert O et al., 2013 (23) 23991656	Aim: To assess if thrombus aspiration reduces mortality in STEMI pts. Study type: Randomized Size: 7244 (3621 thrombectomy, 3623 PCI alone)	Inclusion criteria: • Chest pain, at least for 30 min • Onset of sx to admission<24 h • STEMI or LBBB Exclusion criteria: • Need for CABG • Previous randomization in TASTE trial	Intervention: Thrombus aspiration before PCI (3621) Comparator: PCI only (3623)	1° endpoint: All-cause mortality at 30 d Thrombus aspiration vs PCI only: • 2.8% vs 3.0%; HR: 0.94; 95% CI: 0.72-1.22; p=0.63	• Rate of rehospitalization for recurrent MI at 30 d : HR:0.61; 95% CI:0.34-1.07; p=0.09 • Rate of stent thrombosis: HR: 0.47; 95% CI: 0.20-1.02; p=0.06). • TVR did not differ between groups • Bias due to the treating physician being aware of the group to which pt was assigned and entering the angiographic variables. No adjudication of events and no blinded review of angiograms
INFUSE-AMI Stone GW, et al., 2012 (24) 22447888	Aim: To evaluate reduction of infarct size by IC abciximab, manual aspiration thrombectomy or both (with bivalirudin anticoagulation) Study type: Randomized, 2x2 factorial design Size: 353 with evaluable MRI in thrombectomy arms (thrombectomy=174; no thrombectomy=179)	Inclusion criteria: • STEMI >30 min and ≥1 mm • PPCI sx-onset-to-device time of ≤5 h Exclusion criteria: • Prior MI, CABG, or LAD stent • Shock or CPR • Prior lytic or IIb/IIIa inhibitor for the present admission	Intervention: Thrombectomy (174) Comparator: No thrombectomy (179)	1° endpoint: Infarct size at 30 d as assessed by cardiac MRI Thrombectomy vs no thrombectomy: Infarct size 17.0% vs 17.3% (p=0.51)	• There were also no significant differences in absolute infarct mass or abnormal wall motion score
EXPIRA Sardella G, et al., 2009 (25) 19161878	Aim: To determine the effects of manual thrombectomy device on myocardial perfusion and infarct size assessed by CE-MRI Study type: Randomized Size: 175	Inclusion criteria: • 1st STEMI <9 h from sx onset • Infarct-related artery ≥2.5 mm in diameter • Thrombus score ≥3 • TIMI flow grade ≤1 Exclusion criteria: Cardiogenic shock, 3 vessel/ left main disease, TIMI >0-1, TS <3, contra to GPIIb/IIIa	Intervention: Manual thrombectomy-PCI (88) Comparator: PCI alone (87)	1° endpoint: Occurrence of final myocardial blush grade ≥2 Manual thrombectomy vs.PCI alone 88% vs. 60%; p=0.001	• Rate of ST resolution >70%; (manual thrombectomy-PCI vs. PCI [64% vs.39%; p=0.001]) • Cardiac death at 9 mos lower with manual thrombectomy-PCI (p=0.02) • CE-MRI substudy: presence and extent of MVO in acute phase (significantly lower with manual thrombectomy-PCI) and infarct size extent at 3 mo (significant reduction with manual thrombectomy-PCI) • Single center experience with small no. of pts.

TAPAS Vlaar PJ, et al., 2008 (26) 18539223	Aim: To determine cardiac death or reinfarction rate at 1y Study type: Randomized Size: 1071	Inclusion criteria: • AMI sx >30 min • Time from sx onset <12 h, STE >0.1mV in ≥2 leads Exclusion criteria: • Rescue PCI after thrombolysis • Known concomitant disease with life expectancy <6 mo	Intervention: Thrombus aspiration (535); 1 y f/u (530) Comparator: PCI (536); 1 y f/u PCI (530)	1° endpoint: Combined cardiac death or non-fatal re-MI at 1y; Thrombus aspiration vs. PCI alone: 5.6% vs.9.9% [HR: 1.81; 95% CI: 1.16-2.84; p=0.009]	• 1 y cardiac death: Thrombus aspiration vs. PCI:3.6% vs.6.7% [HR: 1.93; 95% CI: 1.11-3.37; p=0.02] • Limited power to assess clinical outcome. No systematic measurement of infarct size or LVF performed.
Svilaas T, et al., 2008 (27) 18256391	Aim: To assess whether manual thrombus aspiration is superior to conventional treatment during primary PCI Study type: Randomized Size: 1071	Inclusion criteria: • AMI sx >30 min • Time from sx onset <12 • STE >0.1 mV in ≥2 leads Exclusion criteria: • Rescue PCI after thrombolysis • Known concomitant disease with life expectancy <6 mo	Intervention: Thrombus aspiration (535) Comparator: PCI alone (536)	1° endpoint: Post procedure myocardial blush grade of 0 (no myocardial blush) or 1 (minimal myocardial blush or contrast density). Thrombus aspiration vs. PCI alone: 17.1 % vs.26.3% [RR: 0.65; 95% CI: 0.51-0.83; p<0.001]	• Thrombus aspiration vs. PCI alone at 30-day: o Major bleeding: 3.8% vs.3.4%, RR: 1.11; 95% CI: 0.60-2.08; p=0.11 o Target vessel revascularization: 4.5% vs.5.8%, RR: 0.77; 95% CI 0.46-1.30; p=0.34), o Reinfarction: 0.8% vs.1.9%, RR: 0.40; 95% CI: 0.13-1.27; p=0.11, o Death:2.1% vs.4.0%, RR: 0.52; 95% CI 0.26-1.07; p=0.07 o MACE: 6.8% vs.9.4%, RR: 0.72; 95% CI: 0.48-1.08; p=0.12 • Single-center study using surrogate endpoints (myocardial blush grade and ECG variables); performed randomization prior to coronary angiography (selection bias since some patients did not undergo PCI/received alternative therapy)

CABG indicates coronary artery bypass graft; CE-MRI, contrast enhanced MRI; CI, confidence interval; cMRI, cardiac magnetic resonance imaging; Contra, contraindications; CrCl, creatinine clearance; CV, cardiovascular; ECG, electrocardiogram; EM, Export Medtronic; GP2B/3A, glycoprotein IIb/IIIa; Hgb, hemoglobin; Hosp., hospitalization; HR, hazard ratio; IC, intracoronary; ITT, intention-to-treat; LVF, Left ventricular function; MACE, major adverse cardiac events; MACCE, major adverse cardiac and cerebrovascular events; MI, myocardial infarction; MVO, microvascularobstruction; NYHA, New York Heart Association; OR, odds ratio; PCI, percutaneous coronary intervention; PL, platelet count; RCT, randomized controlled trial; RR, relative risk; STEMI, ST-elevation myocardial infarction; STR, ST-segment resolution; SVG, Saphenous venous graft; TIMI, Thrombolysis In Myocardial Infarction; TS, thrombus score; and TVR, target vessel revascularization.

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Author Relationships With Industry and Other Entities (Comprehensive)—2015 ACC/AHA/SCAI Focused Update on Primary Percutaneous Coronary Intervention for Patients With ST-Elevation Myocardial Infarction (Percutaneous Coronary Intervention Writing Committee) (November 2014)

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ABIM indicates American Board of Internal Medicine; ACC, American College of Cardiology; AHA, American Heart Association; AMA, American Medical Association; CathPCI, catheterization and/or percutaneous intervention; DSMB, data safety monitoring board; ECG, electrocardiogram; NCDR, National Cardiovascular Data Registry; NHLBI, National Heart, Lung, and Blood Institute; NIH, National Institutes of Health; PARTNER II trial, Placement of Aortic Transcatheter Valves; and SCAI, Society for Cardiovascular Angiography and Interventions.

Author Relationships With Industry and Other Entities (Comprehensive)—2015 ACC/AHA/SCAI Focused Update on Primary Percutaneous Coronary Intervention for Patients With ST-Elevation Myocardial Infarction (ST-Elevation Myocardial Infarction Writing Committee) (February 2014)

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†No financial benefit.
‡Dr. Deborah D. Ascheim accepted a position at Capricor Therapeutics in August 2015, after the writing effort was completed. In accordance with ACC/AHA policy, she recused herself from the final voting process.

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