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Deferred Versus Immediate Stenting in Patients With ST-Segment Elevation Myocardial Infarction: A Systematic Review and Meta-Analysis

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***Background*—**A number of studies have evaluated the efficacy of deferred stenting vs immediate stenting in patients with ST-segment elevation myocardial infarction, but the findings were not consistent across these studies. This meta-analysis aims to assess optimal treatment strategies in patient with ST-segment elevation myocardial infarction.

***Methods and Results*—**We searched the PubMed, EMBASE, and the Cochrane Library for studies that assessed deferred vs immediate stenting in patients with ST-segment elevation myocardial infarction. Nine studies including 1456 patients in randomized controlled trials and 719 patients in observational studies were included in the meta-analysis. No significant differences were observed in the incidence of no- or slow-reflow between deferred stenting and immediate stenting in randomized controlled trials (odds ratio [OR] 0.51, 95%CI 0.17-1.53, P=0.23, I^2=70%) but not in observational studies (OR 0.13, 95%CI 0.06-0.31, P<0.0001, I^2=0%). Deferred stenting was associated with an increase in long-term left ventricular ejection fraction (weighted mean difference 1.90%, 95%CI 0.77-3.03, P=0.001, I^2=0%). No significant differences were observed in the rates of major adverse cardiovascular events (OR 0.53, 95%CI 0.27-1.01, P=0.06 [randomized OR 0.98, 95%CI 0.73-1.30, P=0.87, I^2=0%; nonrandomized OR 0.30, 95%CI 0.15-0.58, P=0.0004, I^2=0%]), major bleeding (OR=0.1.61, 95%CI 0.70-3.69, P=0.26, I^2=0%), death (OR=0.78, 95% CI 0.53-1.15, P=0.22, I^2=0%), MI (OR=0.97, 95%CI 0.34-2.78, P=0.96, I^2=35%) and target vessel revascularization (OR 0.97, 95%CI 0.40-2.37, P=0.95, I^2=24%), between deferred and immediate stenting.

***Conclusions*—**Compared with immediate stenting, a deferred-stenting strategy did not reduce the occurrence of no- or slow-reflow, death, myocardial infarction, or repeat revascularization compared with immediate stenting in patients with ST-segment elevation myocardial infarction, but showed an improved left ventricular function in the long term. **(*J Am Heart Assoc*. 2017;6: e004838. DOI: 10.1161/JAHA.116.004838.)**

Key Words: deferred stenting • immediate stenting • meta-analysis • ST-segment elevation myocardial infarction

Primary percutaneous coronary intervention (PCI) with stenting implantation is the current standard treatment for patients with ST-segment elevation myocardial infarction (STEMI).[1,2] However, no reflow occurs in 5% to 10% of patients after primary PCI, which is associated with an impaired prognosis.[3-5] It is unknown whether disturbances in the microcirculation were entirely caused by distal embolization from the ruptured plaque or not. To date, attempts to avoid embolization by using thrombectomy or distal protection devices have not been proved efficacious.[6,7]

The concept of deferred stent implantation after restoration of normal epicardial flow by a minimalist immediate mechanical intervention (MIMI) for STEMI management was proposed for the first time by Isaaz et al.[8] Several subsequent observational studies have suggested that deferred stenting was associated with higher rates of procedural success, higher 6-month left ventricular ejection fraction (LVEF), and lower rates of adverse events compared with immediate stenting.[9-11] Recently, findings from new randomized controlled trials (RCTs) were available, showing some inconsistent results with previous observational studies.[12,13] To provide a clearer understanding of this important issue, we performed a meta-analysis of deferred vs immediate stenting in patients with acute STEMI.

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An accompanying Figure S1 is available at http://jaha.ahajournals.org/content/6/3/e004838/DC1/embed/inline-supplementary-material-1.pdf

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Methods

Data Source and Search Strategy

The search strategy involved a literature search of published articles through the medical databases of PubMed, EMBASE, and Cochrane Central Register of Controlled Trials (CENTRAL) up to September 29, 2016. The following medical subject headings and keyword search terms were included for MEDLINE search and adapted for other databases as needed: "delayed," "deferred," "postponed," "stent," "percutaneous coronary intervention," "PCI," "percutaneous coronary angioplasty,,(PTCA)," "STEMI," and "myocardial infarction (MI)." In addition, the reference lists of retrieved articles were scanned for relevant studies. We did not apply any restriction on languages.

Study Inclusion and Exclusion Criteria

Trials were included if they compared deferred stenting with immediate stenting in patients with acute STEMI. All RCTs and observational studies that fulfilled the inclusion criteria were included. Studies comparing early vs late invasive management following thrombolytics or adjunctive anticoagulation were not considered in this analysis. Some conference abstracts without access to full text for quality assessment and data extraction were also excluded.

Data Extraction and Quality Assessment

Two authors (J.Q. and L.P.) reviewed the trials to ensure that they met the inclusion criteria. Data extraction was conducted by mutual agreement. Disagreements were resolved by consensus. The quality of RCTs was assessed by evaluating the following methodological criteria recommended by Cochrane Collaboration: sequence generation of the allocation, concealment of allocation, blinding, incomplete outcome data, selective outcome reporting, and other sources of bias.[14] The quality of observational studies was assessed by the Newcastle-Ottawa Scale criteria.[15]

Study Outcomes and Definitions

The primary endpoint was the incidence of no or slow reflow, defined as absent flow (TIMI Flow Grade 0), incomplete filling (TIMI Flow Grade 1), or slow reflow but complete filling (TIMI Flow Grade 2) of the culprit coronary artery during or at the end of the PCI as revealed by the coronary angiograph. The secondary endpoints were major adverse cardiovascular events (MACE), all-cause death, myocardial infarction (MI), and target vessel revascularization (TVR) at the longest available follow-up. We also assessed the recovery of left ventricular function in the long term (>6 months) using LVEF. MACE typically included death, MI, recurrent ischemia, TVR, and, in some trials, stroke but was defined individually by each trial. Definitions of clinical events are described in Table 1.[16-19]

Statistical Analyses

Review Manager (RevMan5.2, The Cochrane Collaboration, Oxford, UK) and STATA software 11.0 (StataCorp, College Station, TX) were utilized for meta-analyses. For dichotomous outcomes, results were expressed as odds ratio (OR) with 95%CI. For continuous outcomes, pooled data were described with the weighted mean difference and 95%CI. Heterogeneity was assessed using the I^2 statistic, with values <25%, 25% to 50%, >50% indicating low, moderate, and high heterogeneity, respectively.[20] Publication bias was assessed by visually inspecting the funnel plots and by performing an Egger test, and a $P<0.05$ was considered to indicate the existence of significant publication bias.[21] In addition, we performed sensitivity analyses by removing an individual study each time to test the robustness of our findings. Meta-analyses were calculated using random-effect models.[22] All tests were 2-sided, and $P\leq0.05$ was considered statistically significant.

Results

Search Results

The literature search yielded 2996 potentially relevant articles (Figure 1). Through a review of titles and abstracts, 2962 articles were excluded for being duplicated or not relevant. The remaining 34 full-text articles were reviewed and assessed according to the inclusion and exclusion criteria. Ultimately, 9 articles[8-13,23-25] met the inclusion criteria and were included in the meta-analysis (Figure 1), yielding a total of 2175 patients. Among them, 3 studies (1456 patients) were RCTs, and the other 6 studies (719 patients) were observational studies.

Study Characteristics

The baseline characteristics of individual studies were summarized in Table 2. Trials varied from each other with respect to sample size. The smallest of the studies included only 74 subjects. The largest trial enrolled 1214 subjects. Most participants were males with an average age varying from 57.5 to 68 years between studies. Of all patients 30% to 56% had hypertension, 7.5% to 27% had diabetes, 3% to 28% had a history of prior MI, and 34.5% to 74% were smokers. The deferral interval between the initial

Table 1. Definitions of Deferred Stenting and Some Clinical Events

Study	Deferred Stenting	MACE Definition	Major Bleeding Definition	MI Definition
DEFER-STEMI[23]	The deferred PCI strategy involved an intention-to-stent 4 to 16 hours after initial coronary reperfusion	Composite of cardiovascular death, nonfatal MI, unplanned hospitalization for transient ischemic attack or stroke	According to the Acute Catheterization and Urgent Intervention Triage strategY (ACUITY) criteria[16]	According to the Third Universal Definition of Myocardial Infarction[17]
MIMI[13]	Patients in the deferred-stenting group underwent a second coronary arteriography 24 to 48 hours after the first for stent implantation	Death, recurrent MI, stent thrombosis, stroke	According to the TIMI definition[18]	NR
DANAMI 3-DEFER[12]	Repeat coronary angiography with the intention to implant a stent in the infarct-related artery was scheduled about 48 hours (at least 24 hours) after the index procedure	Composite of all-cause mortality, hospital admission for heart failure, recurrent myocardial infarction, or unplanned revascularization of the infarct-related artery	If blood transfusion or surgical intervention was needed	Typical chest pain accompanied by a rise of more than 2 times the upper reference limit of troponins, development of new Q waves on the electrocardiogram, or both
Isaaz et al[8]	Stenting of the infarct-related artery was performed 24 hours after the initial procedure in patients in whom angioplasty was considered as the optimal revascularization approach and who had residual stenosis >50% with a thrombus score <2	NR	NR	NR
Meneveau et al[9]	Patients in the deferred-stenting group underwent PCI that had been delayed by 24 hours after initial diagnostic angiography	Death, recurrent ischemia, TVR	According to the TIMI definition[18]	NR
Tang et al[24]	In the deferred-stenting group, PCI was performed after intensive pharmacologic treatment for 7 days after thrombus aspiration	Cardiac death, nonfatal infarction, recurrent ischemia, or target lesion revascularization and congestive heart failure	NR	NR
Ke et al[10]	In the deferred-stenting group, stent implantation at least 7 days after initial angiography	Combined occurrence of death or myocardial infarction or TVR or heart failure	According to the TIMI definition[18]	Recurrent symptoms with a new onset of ST elevation or a complete left bundle branch block or with at least 20% reelevation of CK-MB between 2 assays
Harbaoui et al[25]	A second angiography was performed for elective PCI within a delay generally >24 hours except in case of ischemic recurrence	NR	The necessity of blood transfusion or 2 g/dL decrease of hemoglobin	NR
Pascal et al[11]	Patients in the deferred-stenting group underwent delayed stenting when optimal reperfusion was achieved. (The deferral interval was not reported.)	Cardiovascular death, recurrent MI, and ischemia-driven TVR	Bleeding Academic Research Consortium (BARC) criteria[19]	NR

CK-MB indicates creatine kinase–myocardial band; DANAMI 3-DEFER, Danish study of optimal acute treatment of patients with ST-segment elevation myocardial infarction; DEFER-STEMI, a randomized trial of deferred stenting vs immediate stenting to prevent no or slow reflow in acute ST-segment elevation myocardial infarction; MACE, major adverse cardiovascular events; MI, myocardial infarction; MIMI, a prospective, randomized, open-label minimalist immediate mechanical intervention trial; NR, not reported; PCI, percutaneous coronary intervention; TIMI, thrombolysis in myocardial infarction; TVR, target vessel revascularization.

reperfusion and stent implantation was quite different in each study and ranged from 4 hours to 7 days. The follow-up period ranged from 6 months to 2 years except for 3 studies that had no postdischarge events reported. The quality scales of these studies are shown in Tables 3 and 4.

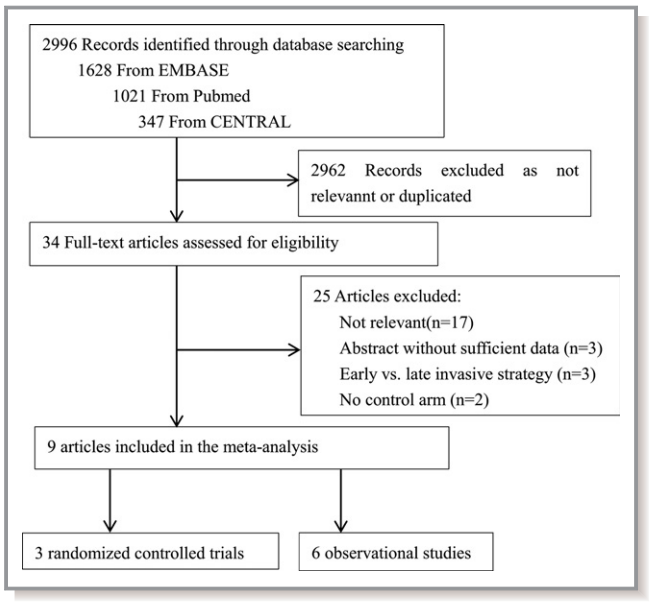

Figure 1. Flowchart of the study selection procedure.

No or Slow Reflow

Three RCTs and 5 observational studies contributed to the analysis of the incidence of no or slow reflow. The results were not significantly different between the 2 groups in RCTs but showed a trend toward decreased risk in the deferred-stenting group (OR 0.51, 95%CI 0.17-1.53, *P*=0.23; Figure 2). The deferred-stenting group had a significantly lower rate of no or slow reflow compared to those receiving immediate stenting in observational studies (OR 0.13, 95%CI 0.06-0.31, *P*<0.0001; Figure 2). Results of randomized and nonrandomized studies were combined and showed a similar result with observational studies (OR 0.25, 95%CI 0.10-0.62, *P*=0.002; Figure 2). It was notable that significant heterogeneity was also detected when results of randomized and nonrandomized studies were combined (I^2=67%), and significant publication bias was found (*P*=0.013; Figure S1A). Sensitivity analysis demonstrated similar results when each individualized study was removed.

Incidence of MACE

Three RCTs and 4 observational studies contributed to the analysis of MACE. Compared with immediate stenting, deferred stenting was associated with a significant reduction of MACE in observational studies (OR 0.30, 95%CI 0.15-0.58, *P*=0.0004; Figure 3), but the association was not significant in RCTs (OR 0.98, 95%CI 0.73-1.30, *P*=0.87; Figure 3). No heterogeneity was observed either in RCTs (I^2=0) or in observational studies (I^2=0), but significant heterogeneity was observed when results of randomized and nonrandomized studies were combined (I^2=54%). No publication bias was

Table 2. Baseline Characteristics of the Included Studies

Study	Year	Design	Study Size (n) DS/IS	Mean Age (y) DS/IS	Male (%) DS/IS	Hypertension (%) DS/IS	Diabetes Mellitus (%) DS/IS	Dyslipidemia (%) DS/IS	Smoking (%) DS/IS	Previous MI (%) DS/IS	Previous PCI (%) DS/IS	Baseline LVEF (%) DS/IS	Follow-Up
DEFER-STEMI[23]	2014	RCT	52/49	57.6/61.7	65.4/73.5	NR	13.5/12.2	NR	NR	9.6/4.1	3.8/4.1	NR	6 months
MIMI[13]	2016	RCT	67/73	60.6/55	76.1/86.3	41.8/19.2	14.9/8.2	NR	59.7/74	4.5/5.5	4.5/4.1	51/53	6 months
DANAMI 3-DEFER[12]	2016	RCT	603/612	61/62	76/74	41/41	9/9	NR	54/51	6/7	NR	50/50	2 years
Isaaz et al[8]	2006	Non-RCT	58/16	58*	76.3*	38*	11*	43*	66*	3*	8*	NR	In-hospital stay
Meneveau et al[9]	2009	Non-RCT	39/39	64/60	77/74	44/49	21/18	64/62	NR	NR	46	53.1/53.5	In-hospital stay
Tang et al[24]	2011	Non-RCT	40/47	68/64	47.5/59.6	43.5/51.1	15/19.1	37.5/48.9	47.5/57.4	NR	NR	50/58	6 months
Ke et al[10]	2012	Non-RCT	53/50	57.5/60.8	81.1/76	35.8/30	17/14.6	24.5/20.4	34.5	28	7.5/6	49.68/51.62	1 year
Harbaoui et al[25]	2015	Non-RCT	40/58	60.1/68	80/63.8	37.5/49.1	7.5/15.8	52.5/33.3	47.5/36.2	NR	15/3.5	NR	In-hospital stay
Pascal et al[11]	2016	Non-RCT	56/223	57.9/63.1	89/74	50/56	27/20	79/65	86/66	NR	NR	NR	1 year

DANAMI 3-DEFER indicates Danish study of optimal acute treatment of patients with ST-segment elevation myocardial infarction; DEFER-STEMI, a randomized trial of deferred stenting vs immediate stenting to prevent no or slow reflow in acute ST-segment elevation myocardial infarction; DS, deferred stenting; IS, immediate stenting; MI, myocardial infarction; MIMI, a prospective, randomized, open-label minimalist immediate mechanical intervention trial; NR, not report; PCI, percutaneous coronary intervention; RCT, randomized controlled trials.
*For overall population (separate data for each group were not reported).

Table 3. Assessment of RCTs (Cochrane Collaboration Tool for Assessing Risk of Bias)

Trial name	Sequence Generation	Concealment of Allocation	Blinding of Participant	Blinding of Outcome Assessment	Imcomplete Outcome Data Addressed	Free of Selective Reporting	Free of Other Bias
DEFER-STEMI[23]	Y	Y	N	Y	Y	Y	Y
MIMI[13]	Y	Y	N	Y	Y	Y	Y
DANAMI 3-DEFER[12]	Y	Y	N	Y	Y	Y	Y

DANAMI 3-DEFER indicates Danish study of optimal acute treatment of patients with ST-segment elevation myocardial infarction; DEFER-STEMI, a randomized trial of deferred stenting vs immediate stenting to prevent no or slow reflow in acute ST-segment elevation myocardial infarction; MIMI, A prospective, randomized, open-label minimalist immediate mechanical intervention trial; N, no; RCT, randomized controlled trials; Y, yes.

found, as shown by Egger test (P=0.108; Figure S1B). Sensitivity analyses revealed similar results either in RCTs or in observational studies when each individualized study was removed.

Major Bleeding

One RCT and 2 observational studies contributed to the analysis of major bleeding. No significant association was detected in RCTs (OR 1.61, 95%CI 0.62-4.17, P=0. 33; Figure 4) and in observational studies (OR 1.63, 95%CI 0.31-8.64, P=0.55; Figure 4). No heterogeneity was observed (I^2=0).

All-Cause Mortality

Three RCTs and 4 observational studies contributed to the analysis of mortality. No significant difference was observed between deferred stenting and immediate stenting in RCTs (OR 0.84, 95%CI 0.55-1.26, P=0.39; Figure 5) or in observational studies (OR 0.50, 95%CI 0.17-1.50, P=0.22; Figure 5). Also, no evidence of significant heterogeneity was detected in either analyses (I^2=0), and no publication bias was observed (P=0.60; Figure S1D). None of the individual studies significantly influenced the pooled all-cause mortality estimation in the leave-1-out sensitivity analysis.

Myocardial Infarction

Two RCTs and 2 observational studies contributed to the analysis of MI. No significant association was detected in RCTs (OR 1.60, 95%CI 0.42-6.14, P=0.49; Figure 6) or in observational studies (OR 0.27, 95%CI 0.04-1.70, P=0.16; Figure 6). A moderate heterogeneity was observed in RCTs (I^2=47%) but not in observational studies (I^2=0). None of the individual studies significantly influenced the results; publication bias was not observed (P= 0.776; Figure S1E).

Table 4. Assessment of Observational Studies (Newcastle-Ottawa Scale Criteria)

	Selection				Comparability	Outcomes		
Studies	Representativeness of the Exposed Cohort	Selection of the Nonexposed Cohort	Ascertainment of Exposure	Demonstration That Outcome of Interest Was Not Present at Start of Study	Comparability of Cohorts on the Basis of the Design or Analysis	Assessment of Outcome	Was Follow-Up Long Enough for Outcomes to Occur	Adequacy of Follow-Up of Cohorts
Isaaz et al[8]	A	A	A	A	A	D	A	A
Meneveau et al[9]	A	A	A	A	A	B	A	A
Tang et al[24]	A	A	A	A	A	A	A	A
Ke et al[10]	A	A	A	A	A	B	A	A
Harbaoui et al[25]	A	A	A	A	A	A	A	A
Pascal et al[11]	A	A	A	A	A	B	A	A

Representativeness of the exposed cohort: A, truly representative of the average patient with ischemic heart disease; B, somewhat representative of the average patient with ischemic heart disease; C, selected group; and D, no description of the derivation of the cohort. Selection of the nonexposed cohort: A, drawn from the same community as the exposed cohort; B, drawn from a different source; and C, no description of the derivation of the nonexposed cohort. Ascertainment of exposure: A, secure record (eg, surgical records); B, structured interview; C, written self-report; and D, no description. Demonstration that outcome of interest was not present at start of study: A, yes; B, no. Comparability of cohorts on the basis of the design or analysis: A, study controls for comorbidities; B, study controls for additional risk factors (such as age and severity of illness); and C, not done. Assessment of outcome: A, independent blind assessment; B, record linkage; C, self-report; and D, no description. Was follow-up long enough for outcomes to occur: A, yes; B, no. Adequacy of follow-up of cohorts: A, complete follow-up—all subjects accounted for; B, subjects lost to follow-up unlikely to introduce bias (small number lost), follow-up rate higher than 90%, or description provided of those lost; C, follow-up rate 90% or lower (select an adequate percentage) and no description of those lost; and D, no statement.

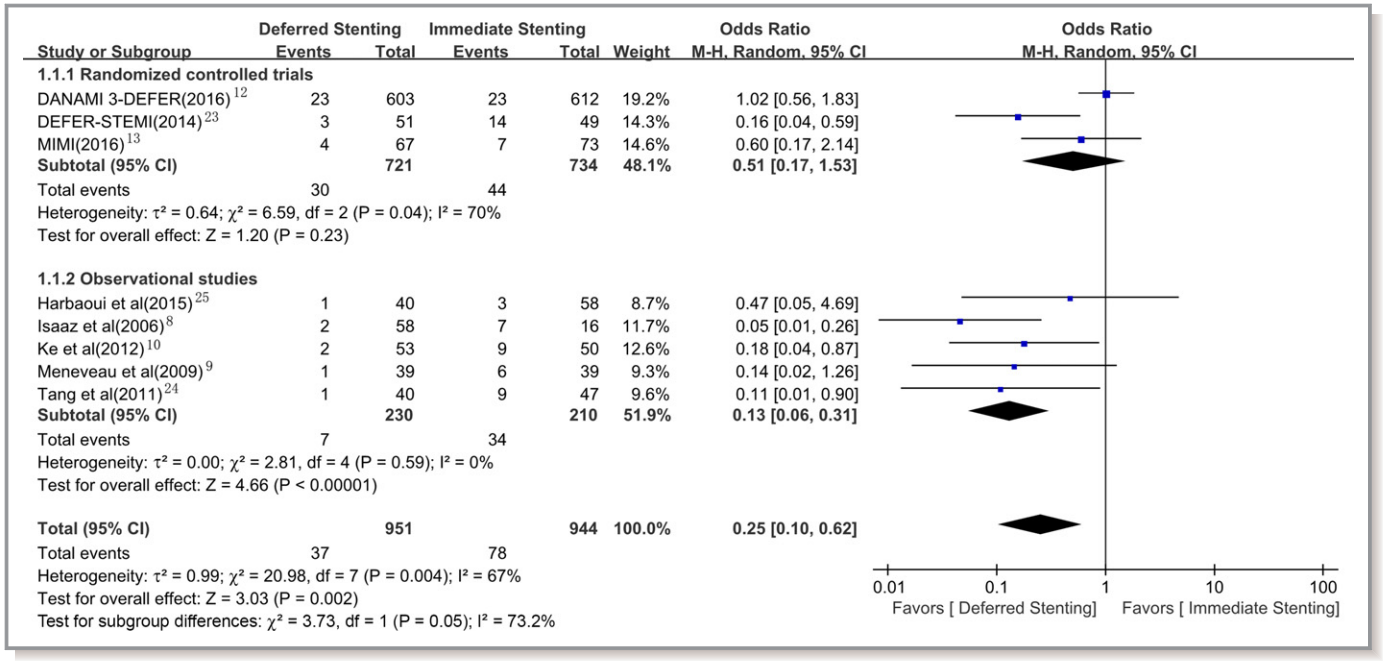

Figure 2. Forrest plot of the incidence of no or slow reflow in deferred- vs immediate-stenting groups. M-H indicates Mantel-Haenszel.

Target Vessel Revascularization

One RCT and 4 observational studies contributed to the analysis of TVR. Deferred stenting was associated with a significantly higher rate of TVR when compared with immediate stenting in RCT (OR 1.77, 95%CI 1.04-3.00, *P*=0.03; Figure 7), but this difference was not maintained in observational studies (OR 0.43, 95%CI 0.12-1.51, *P*=0.19; Figure 7). No significant differences between the 2 groups were observed when results of randomized and nonrandomized studies were combined (OR 0.97, 95%CI 0.40-2.37, *P*=0.95; Figure 7). No heterogeneity was observed (I^2=24%). It was notable that significant publication bias was found (*P*=0.041; Figure S1F).

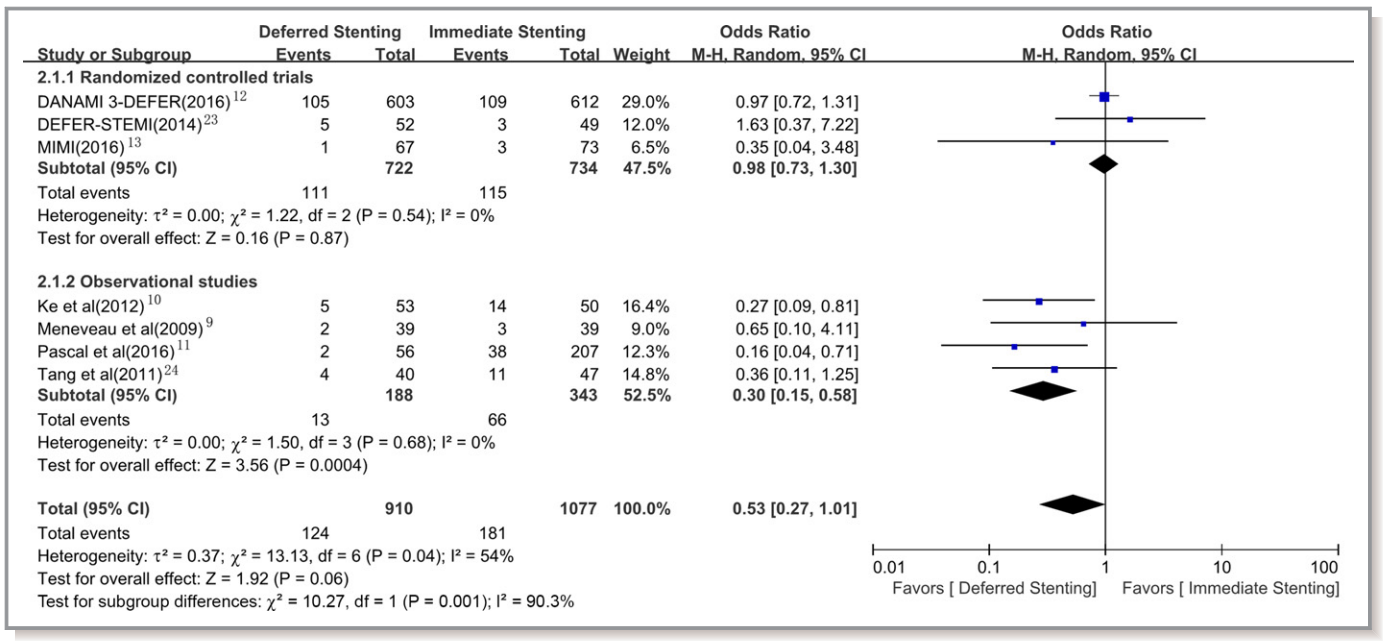

Figure 3. Forrest plot of the incidence of major adverse cardiovascular events in deferred- vs immediate-stenting groups. M-H indicates Mantel-Haenszel.

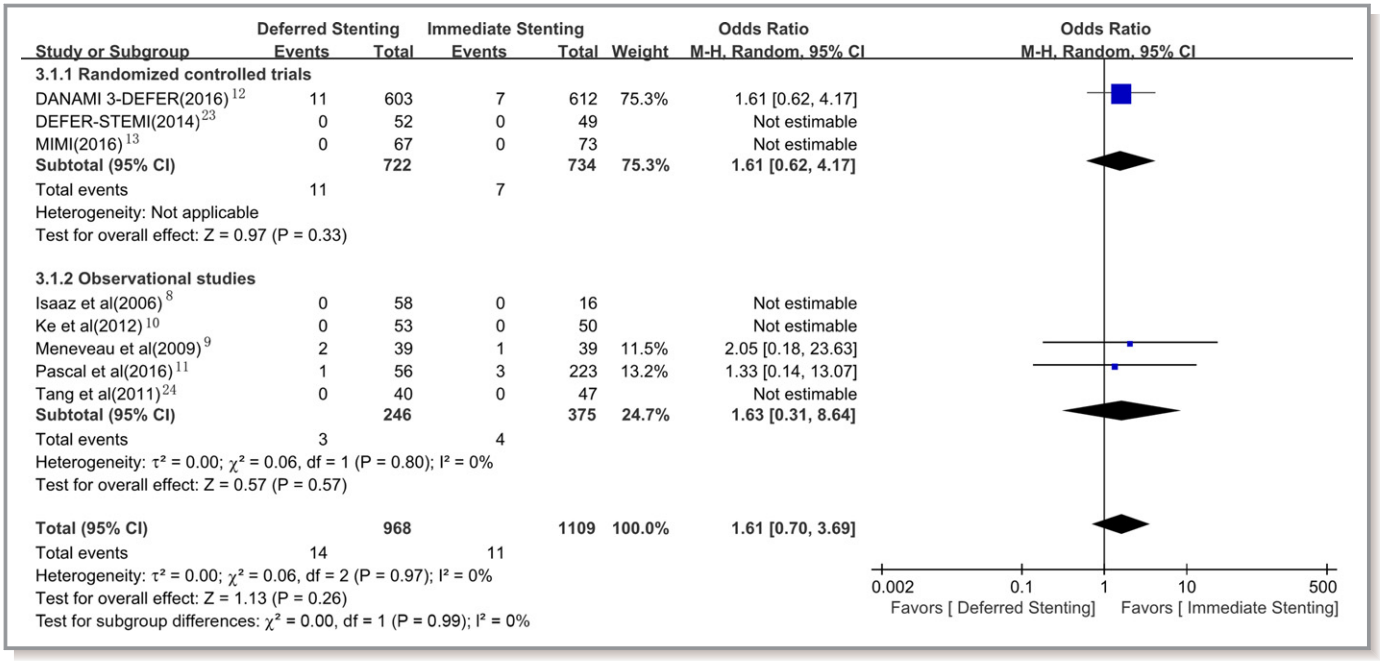

Figure 4. Forrest plot of the incidence of major bleeding in deferred- vs immediate-stenting groups. M-H indicates Mantel-Haenszel.

Long-Term Left Ventricular Ejection Fraction

One RCT and 1 observational study contributed to the analysis of long-term LVEF. LVEF was significantly higher for patients who received deferred-stenting therapy in both RCT (weighted mean difference 1.70%, 95%CI 0.49-2.91, *P*=0.006; Figure 8) and observational study (weighted mean difference 3.40%, 95%CI 0.12-6.68, *P*=0.04; Figure 8). No heterogeneity was observed when results of randomized and nonrandomized studies were combined (I^2=0).

Discussion

Our meta-analysis found that deferred completion of PCI did not prevent no or slow reflow in patients with STEMI

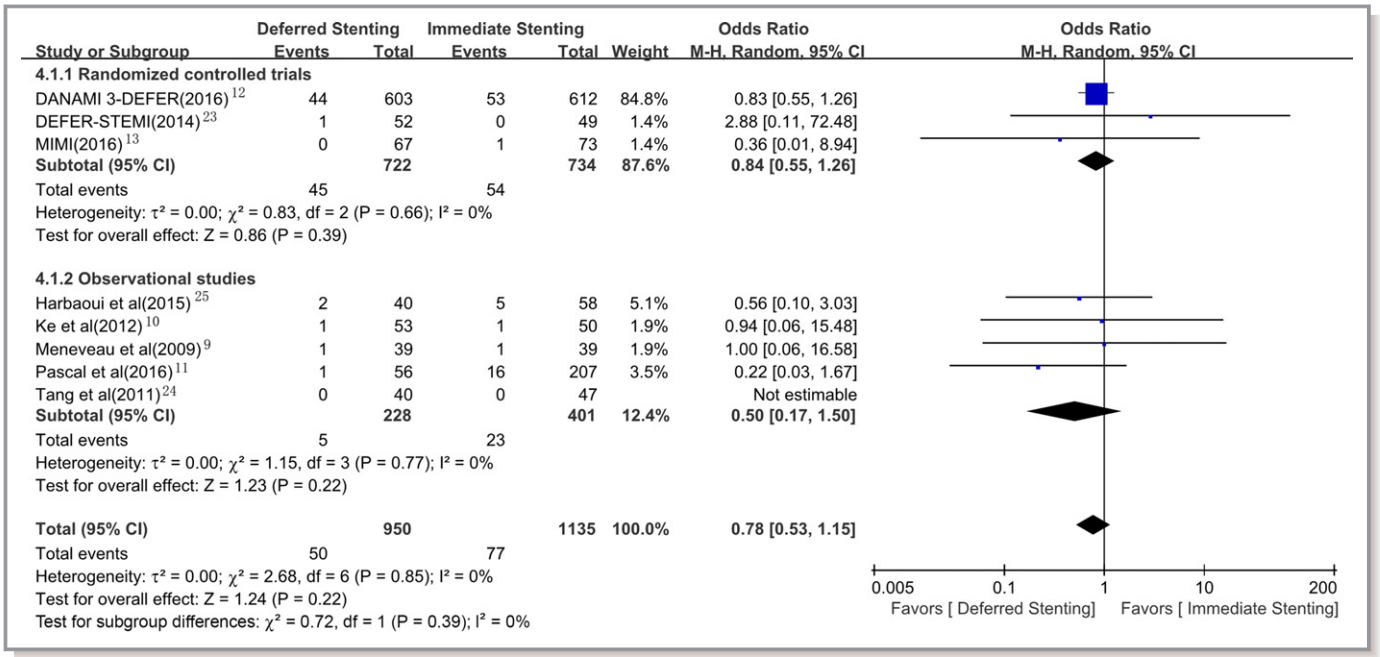

Figure 5. Forrest plot for all-cause mortality in deferred- vs immediate-stenting groups. M-H indicates Mantel-Haenszel.

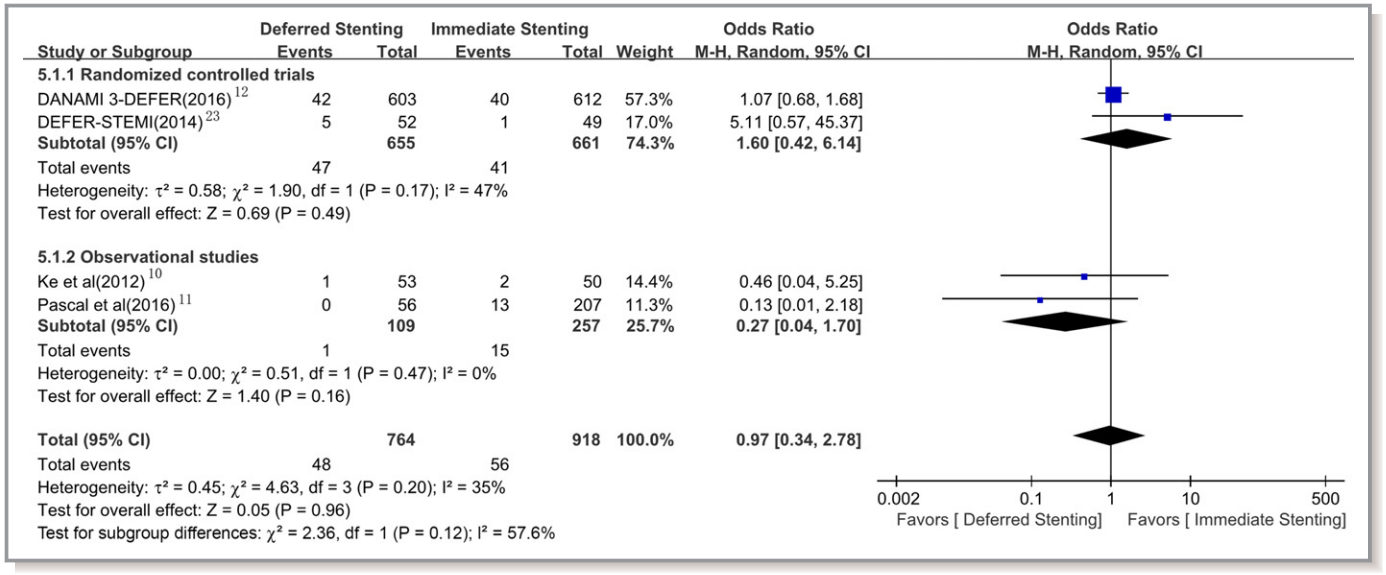

Figure 6. Forrest plot of the incidence of myocardial infarction in deferred- vs immediate-stenting groups. M-H indicates Mantel-Haenszel.

compared with conventional treatment with immediate stenting. Improved long-term LV function was found in the deferred-stenting group, although there was no significant difference in hard clinical outcomes such as MACE.

It is worth noting that the outcomes of no or slow reflow, MACE, and TVR were, in conformity in RCTs and observational studies in our meta-analysis. There are several possible reasons for the discrepancies between RCTs and observational studies. First, the deferral interval from the initial reperfusion to stent implantation varied considerably between studies (from several hours to 1 week). The thrombus grade in the infarct-related artery diminishes considerably 24 to 48 hours after PCI plus the enhanced antithrombotic therapies,[8,26] but whether further postponement of stent implantation would have any benefits is still unknown. Second, the DEFER-STEMI study and most observational studies focused on patients with a high risk of flow disturbances, whereas the DANAMI 3-DEFER study included unselected patients with STEMI, and the MIMI study even excluded patients with an important thrombotic burden. The efficacy of deferred stenting was likely to be the greatest in the patients at highest risk of no or slow reflow, and the risk of recurrent MI could not be mitigated in patients who were at low risk of no reflow on clinical grounds.[23]

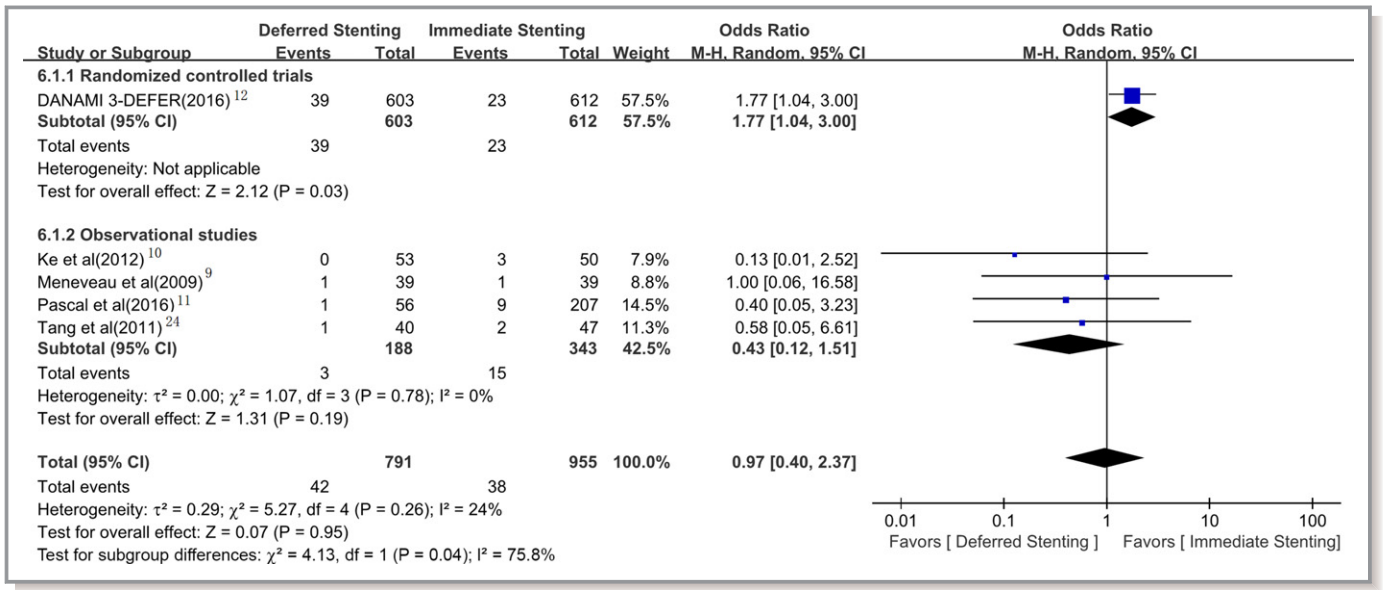

Figure 7. Forrest plot of the incidence of target vessel revascularization in deferred- vs immediate-stenting groups. M-H indicates Mantel-Haenszel.

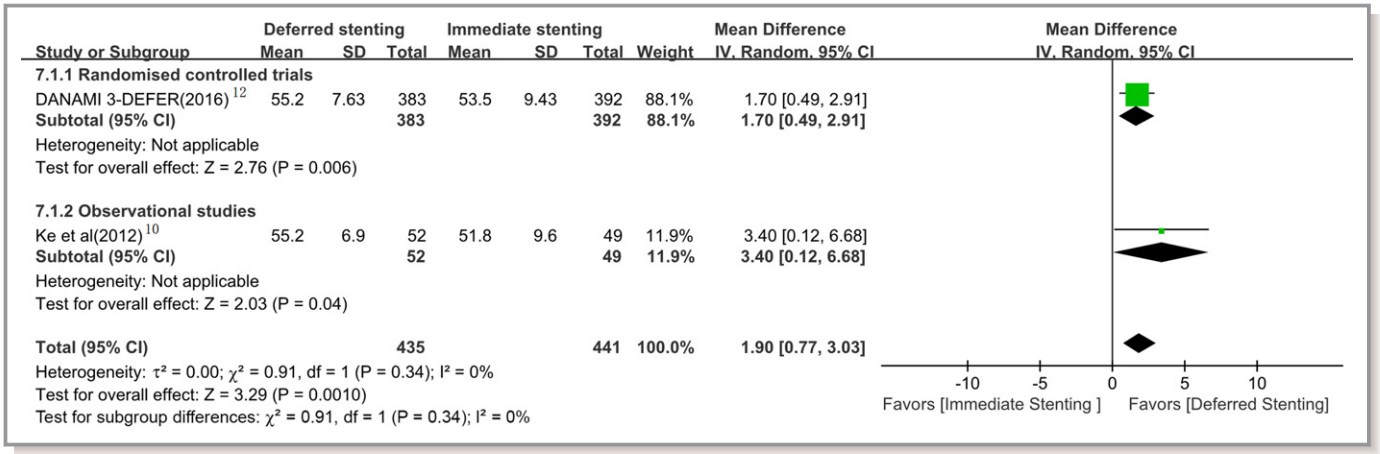

Figure 8. Forrest plot of weighted mean difference of the long-term left ventricular ejection fraction in deferred- vs immediate-stenting groups. IV indicates inverse variance.

There is significant publication bias in the analysis of no or slow reflow and TVR. It was mainly driven by the results of the DANAMI 3-DEFER study, which showed no significant difference in the rate no or slow reflow between the 2 groups and a higher rate of TVR in the deferred-stenting group. However, there was no significant impact on the results if each study was removed individually.

In our meta-analysis we observed a significantly greater improvement in long-term LVEF in the deferred group. The benefit was most likely due to the beneficial effect of deferred stenting on myocardial perfusion.[10] Bethke and colleagues found that the TIMI myocardial perfusion grade at the end of the PCI procedure was significantly associated with LVEF and infarct size after 3 months in STEMI patients.[27]

Our comparative findings were not consistent with a previous meta-analysis,[28] which showed improved angiographic outcomes in deferred-stenting patients. Meanwhile, our meta-analysis differed from it in the following 3 aspects. First, our meta-analysis included more RCTs than the previous one, such as the DEFER-STEMI,[23] MIMI,[13] and DANAMI 3-DEFER trials.[12] It is generally accepted that well-designed RCTs provide definite evidence and an estimate of the treatment effect in a specific, selected, well-defined target patient population. Second, STEMI and non-STEMI patients were combined together in the previous meta-analysis, which might have biased the interpretation of the study as a result of the potential differences in the amount of myocardium at risk and thrombotic mechanism. Finally, we also assessed the recovery of left ventricular function in the long term, which might be associated with the long-term survival.[29]

In addition to reducing the thrombus burden and microvascular obstruction, the deferred-stenting strategy also has some additional advantages. (1) It allows for a better sizing of the lesion and of the artery, leading to an optimized stent selection.[30] (2) It could provide a better appraisal of the revascularization strategy, including avoiding unnecessary stenting when the residual stenosis is not deemed significant.[9] (3) In STEMI case, the repeated angiogram may allow treatment of a nonculprit artery in patients with multivessel disease.[31] However, the disadvantages of deferred-stenting strategy with higher costs, prolonged hospitalization, and the risk of reocclusion should also be considered.

Our meta-analysis found an improved long-term LVEF with the deferred-stenting strategy. Whether the benefits of this strategy could translate into improved survival in the long term needs to be answered by long-term follow-up data from large-scale RCTs such as DEFER-STEMI, MIMI, and DANAMI 3-DEFER trials, the ongoing INNOVATION trial (ClinicalTrials.gov: NCT02324348), and the PRIMACY trial (ClinicalTrials.gov: NCT01542385).

This meta-analysis has several limitations. First, because of limited randomized data, this meta-analysis included both randomized and observational studies. The observational studies are subjected to unmeasured confounding and selection bias, although we made a stratified analysis of randomized and observational studies before the pooled estimate. Second, that the definition of MACE was not completely consistent across studies should be considered, although it was unlikely to have a huge impact on the results of our meta-analysis. Third, we did not make a subgroup analysis in patients with high risk of no reflow or low risk of no reflow because individual patient data were not available. Fourth, this meta-analysis only included studies with full-text articles. Some conference abstracts without access to full text for quality assessment and data extraction were excluded. There may be publication bias in our study. Last but most important, the deferral interval between the initial reperfusion and stent implantation varied across studies, so the optimal delay between the 2 procedures in the deferred-stenting group is still in debate.

Conclusions

In this comparative meta-analysis, a deferred-stenting strategy did not reduce the occurrence of no or slow reflow, death, MI, or repeat revascularization compared with immediate stenting in patients with STEMI but showed an improved LV function in the long term. Results of large-scale RCTs with long-term follow-up might shed further light on clinical endpoints such as death, heart failure, and reinfarction.

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Disclosures

None.

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SUPPLEMENTAL MATERIAL

Figure S1. Funnel plot for evaluation of publication bias.