Is Aspiration Thrombectomy Beneficial in Patients Undergoing Primary Percutaneous Coronary Intervention? Meta-Analysis of Randomized Trials

Islam Y. Elgendy, MD; Tianyao Huo, MS; Deepak L. Bhatt, MD, MPH; Anthony A. Bavry, MD, MPH

Background—It is unclear whether intravenous glycoprotein IIb/IIIa inhibitors or ischemic time might modify any clinical benefits observed with aspiration thrombectomy before primary percutaneous coronary intervention (PCI) in patients with ST-segment–elevation myocardial infarction.

Methods and Results—Electronic databases were searched for trials that randomized ST-segment–elevation myocardial infarction patients to aspiration thrombectomy before PCI versus conventional PCI. Summary estimates were constructed using a DerSimonian-Laird model. Seventeen trials with 20,960 patients were available for analysis. When compared with conventional PCI, aspiration thrombectomy was not associated with a significant reduction in the risk of mortality (2.8% versus 3.2% [risk ratio [RR], 0.89; 95% confidence interval [CI], 0.76–1.04; P=0.13]), reinfarction (1.3% versus 1.4% [RR, 0.93; 95% CI, 0.73–1.17; P=0.52]), the combined outcome of mortality or reinfarction (4.1% versus 4.6% [RR, 0.90; 95% CI, 0.79–1.02; P=0.11]), or stent thrombosis (0.9% versus 1.2% [RR, 0.82; 95% CI, 0.62–1.08; P=0.15]). Aspiration thrombectomy was associated with a nonsignificant increase in the risk of stroke (0.6% versus 0.4% [RR, 1.45; 95% CI, 0.96–2.21; P=0.08]). Meta-regression analysis did not identify a difference for the log RR of mortality, reinfarction, and the combined outcome of mortality or reinfarction with intravenous glycoprotein IIb/IIIa inhibitors (P=0.17, 0.70, and 0.50, respectively) or with ischemic time (P=0.29, 0.66, and 0.58, respectively).

Conclusions—Aspiration thrombectomy before primary PCI is not associated with any benefit on clinical end points and might increase the risk of stroke. Concomitant administration of intravenous glycoprotein IIb/IIIa inhibitors and ischemic time did not seem to influence any potential benefits observed with aspiration thrombectomy. (Circ Cardiovasc Interv. 2015;8:e002258. DOI: 10.1161/CIRCINTERVENTIONS.114.002258.)

Key Words: meta-analysis ■ myocardial infarction ■ percutaneous coronary intervention ■ stroke ■ thrombectomy

Suboptimal coronary reperfusion in patients with STEMI is associated with worse outcomes.1,2 Aspiration thrombectomy has been available as an adjunctive therapy to aid in the restoration of coronary blood flow at the epicardial and microvascular levels. An earlier meta-analysis had suggested that aspiration thrombectomy at the time of primary percutaneous coronary intervention (PCI) was associated with better outcomes; however, recent randomized trials demonstrated the lack of clinical benefits with routine aspiration thrombectomy.4,5 Furthermore, some studies suggested that this adjunctive technology might be associated with an increased risk of stroke.3,4,6

Earlier studies suggested that intravenous glycoprotein IIb/IIIa inhibitors administration was associated with improved outcomes in STEMI patients undergoing primary PCI.7 However, studies conducted in the current era of potent ADP antagonists demonstrated lack of clear clinical outcome benefit with glycoprotein IIb/IIIa inhibitors usage.8–10 A previous retrospective study had suggested that the combination of intravenous glycoprotein IIb/IIIa inhibitors with adjunctive aspiration thrombectomy had better clinical outcomes than either treatment modality separately.11 In the randomized trials evaluating clinical outcomes with aspiration thrombectomy, the usage of glycoprotein IIb/IIIa inhibitors has been variable which could have modified any association between aspiration thrombectomy and adverse cardiovascular outcomes.12–14 In addition, in these trials there was variation in ischemic time, which might also affect any clinical benefit from aspiration thrombectomy.15,16

In this study, we aimed to conduct a comprehensive meta-analysis to evaluate the outcomes associated with aspiration thrombectomy with the totality of data. Moreover, we sought to explore the effect of coadministration of intravenous glycoprotein IIb/IIIa inhibitors as well as ischemic time on any
WHAT IS KNOWN

- The use of adjunctive aspiration thrombectomy at the time of primary percutaneous coronary intervention is associated with improved myocardial reperfusion; however, recent trials have demonstrated lack of clinical benefit.
- Intravenous glycoprotein IIb/IIIa inhibitors are potent antiplatelet agents that have been shown to reduce the risk of ischemic events in patients undergoing primary percutaneous coronary intervention.
- It remains unclear whether coadministration of intravenous glycoprotein IIb/IIIa inhibitors, ischemic time, or other factors might modify any clinical benefits of aspiration thrombectomy.

WHAT THE STUDY ADDS

- Aspiration thrombectomy does not reduce the risk of all-cause mortality, reinfarction, the combined outcome of mortality or reinfarction, major adverse cardiac events, or stent thrombosis when compared with conventional percutaneous coronary intervention. Aspiration thrombectomy might be associated with an increased risk of stroke.
- Concomitant administration of intravenous glycoprotein IIb/IIIa inhibitors at the time of primary percutaneous coronary intervention or ischemic time does not seem to enhance any potential clinical benefits observed with aspiration thrombectomy.

Results

Included Studies

Seventeen trials with 20,960 patients were available for the analysis.4-5,12-15,26-37 The weighted mean follow-up duration was 3.7±2.7 months. Three trials reported outcomes at both 1 and 12 months.5,12,14,38-40 The mean time between the onset of symptoms to primary PCI was similar in both groups (4.5±1.5 hours; \( P=0.86 \)). Five trials defined MACE as the composite of death, reinfarction, stroke, or target vessel revascularization.12,32-34,37 MACE was defined in 5 studies as death, reinfarction, or target vessel revascularization.12,32-34,37

In 1 study, death, reinfarction, or stroke was used as the MACE definition,36 whereas another study used death, reinfarction, or hospitalization for heart failure as the MACE definition.35 Another study defined MACE as composite of death from cardiovascular causes, reinfarction, cardiogenic shock, or New York Heart Association class IV heart failure.4 The remaining 4 studies did not specifically define MACE.5,28-30 All the studies that reported complete ST-segment resolution used the cutoff \( \geq 70\% \).4,12-14,26-28,31-34,37 except for 1 study that used \( \geq 50\% \).32 Seven studies defined successful reperfusion as TIMI blush grade of 3.4,13,14,26,29,32,34,35 whereas 5 studies used TIMI blush grade of \( \geq 2 \).12,28,30,31,37 In Table 1, we summarize the baseline characteristics, the primary outcome, and the follow-up duration of the included studies, whereas Table 2 reports the study medications.

Outcomes

The incidence of all-cause mortality was 2.8% with aspiration thrombectomy versus 3.2% with conventional PCI (RR, 0.89; 95% confidence interval [CI], 0.76-1.04; \( P=0.13 \); \( F=0.0\% \)). On subgroup analysis, the risk of all-cause mortality was similar at 1 month (RR, 0.86; 95% CI, 0.61-1.20; \( P=0.36 \)) and at 12 months (RR, 0.82; 95% CI, 0.61-1.09; \( P=0.17 \)). The incidence of any major adverse cardiac events was 2.4% with aspiration thrombectomy versus 3.0% with conventional PCI (RR, 0.81; 95% CI, 0.66-0.99; \( P=0.04 \)). On subgroup analysis, the risk of any major adverse cardiac events was similar at 1 month (RR, 0.86; 95% CI, 0.66-1.10; \( P=0.24 \)) and at 12 months (RR, 0.83; 95% CI, 0.68-1.00; \( P=0.05 \)). The incidence of reinfarction was 3.8% with aspiration thrombectomy versus 4.8% with conventional PCI (RR, 0.79; 95% CI, 0.66-0.95; \( P=0.01 \)). On subgroup analysis, the risk of reinfarction was similar at 1 month (RR, 0.85; 95% CI, 0.67-1.08; \( P=0.18 \)) and at 12 months (RR, 0.83; 95% CI, 0.68-1.00; \( P=0.05 \)). The incidence of stent thrombosis was 1.2% with aspiration thrombectomy versus 1.7% with conventional PCI (RR, 0.70; 95% CI, 0.49-1.02; \( P=0.06 \)). On subgroup analysis, the risk of stent thrombosis was similar at 1 month (RR, 0.79; 95% CI, 0.57-1.12; \( P=0.16 \)) and at 12 months (RR, 0.76; 95% CI, 0.55-1.05; \( P=0.09 \)). The incidence of ischemic stroke was 0.3% with aspiration thrombectomy versus 0.5% with conventional PCI (RR, 0.63; 95% CI, 0.31-1.29; \( P=0.22 \)). On subgroup analysis, the risk of ischemic stroke was similar at 1 month (RR, 1.0; 95% CI, 0.38-2.58; \( P=0.99 \)) and at 12 months (RR, 0.87; 95% CI, 0.39-1.98; \( P=0.71 \)). The incidence of bleeding events was 5.1% with aspiration thrombectomy versus 5.6% with conventional PCI (RR, 0.92; 95% CI, 0.76-1.12; \( P=0.44 \)). On subgroup analysis, the risk of bleeding events was similar at 1 month (RR, 0.97; 95% CI, 0.71-1.34; \( P=0.45 \)) and at 12 months (RR, 0.92; 95% CI, 0.75-1.12; \( P=0.43 \)). The incidence of life-threatening bleeding was 1.0% with aspiration thrombectomy versus 1.2% with conventional PCI (RR, 0.83; 95% CI, 0.43-1.62; \( P=0.64 \)). On subgroup analysis, the risk of life-threatening bleeding was similar at 1 month (RR, 1.0; 95% CI, 0.44-2.36; \( P=0.99 \)) and at 12 months (RR, 0.83; 95% CI, 0.43-1.62; \( P=0.64 \)). The incidence of all-cause mortality was 2.8% with aspiration thrombectomy versus 3.2% with conventional PCI (RR, 0.89; 95% confidence interval [CI], 0.76-1.04; \( P=0.13 \); \( F=0.0\% \)). On subgroup analysis, the risk of all-cause mortality was similar at 1 month (RR, 0.86; 95% CI, 0.61-1.20; \( P=0.36 \)) and at 12 months (RR, 0.82; 95% CI, 0.61-1.09; \( P=0.17 \)). The incidence of any major adverse cardiac events was 2.4% with aspiration thrombectomy versus 3.0% with conventional PCI (RR, 0.81; 95% CI, 0.66-0.99; \( P=0.04 \)). On subgroup analysis, the risk of any major adverse cardiac events was similar at 1 month (RR, 0.86; 95% CI, 0.66-1.10; \( P=0.24 \)) and at 12 months (RR, 0.83; 95% CI, 0.68-1.00; \( P=0.05 \)). The incidence of reinfarction was 3.8% with aspiration thrombectomy versus 4.8% with conventional PCI (RR, 0.79; 95% CI, 0.66-0.95; \( P=0.01 \)). On subgroup analysis, the risk of reinfarction was similar at 1 month (RR, 0.85; 95% CI, 0.57-1.08; \( P=0.24 \)) and at 12 months (RR, 0.83; 95% CI, 0.68-1.00; \( P=0.05 \)). The incidence of stent thrombosis was 1.2% with aspiration thrombectomy versus 1.7% with conventional PCI (RR, 0.70; 95% CI, 0.49-1.02; \( P=0.22 \)). On subgroup analysis, the risk of stent thrombosis was similar at 1 month (RR, 0.79; 95% CI, 0.57-1.12; \( P=0.16 \)) and at 12 months (RR, 0.76; 95% CI, 0.55-1.05; \( P=0.09 \)). The incidence of ischemic stroke was 0.3% with aspiration thrombectomy versus 0.5% with conventional PCI (RR, 0.63; 95% CI, 0.31-1.29; \( P=0.22 \)). On subgroup analysis, the risk of ischemic stroke was similar at 1 month (RR, 1.0; 95% CI, 0.38-2.58; \( P=0.99 \)) and at 12 months (RR, 0.87; 95% CI, 0.39-1.98; \( P=0.71 \)). The incidence of bleeding events was 5.1% with aspiration thrombectomy versus 5.6% with conventional PCI (RR, 0.92; 95% CI, 0.76-1.12; \( P=0.44 \)). On subgroup analysis, the risk of bleeding events was similar at 1 month (RR, 0.97; 95% CI, 0.44-2.36; \( P=0.99 \)) and at 12 months (RR, 0.92; 95% CI, 0.75-1.12; \( P=0.43 \)). The incidence of life-threatening bleeding was 1.0% with aspiration thrombectomy versus 1.2% with conventional PCI (RR, 0.83; 95% CI, 0.43-1.62; \( P=0.64 \)). On subgroup analysis, the risk of life-threatening bleeding was similar at 1 month (RR, 1.0; 95% CI, 0.44-2.36; \( P=0.99 \)) and at 12 months (RR, 0.83; 95% CI, 0.43-1.62; \( P=0.64 \)).
of reinfarction was 1.3% with aspiration thrombectomy versus 1.4% with conventional PCI (RR, 0.93; 95% CI, 0.73–1.17; P=0.52; F=0%). The incidence of the combined outcome of mortality or reinfarction was 4.1% with aspiration thrombectomy versus 4.6% with conventional PCI (RR, 0.90; 95% CI, 0.79–1.02; P=0.11; F=0%). The incidence of MACE was 6.0% with aspiration thrombectomy versus 6.6% with conventional PCI (RR, 0.90; 95% CI, 0.81–1.00; P=0.06; F=0%). Figure 1 shows the forest plot for all-cause mortality, reinfarction, the combined outcome of mortality or reinfarction, and MACE. The incidence of stent thrombosis was 0.9% with aspiration thrombectomy versus 1.2% with conventional PCI (RR, 0.82; 95% CI, 0.62–1.08; P=0.15; F=0%; Figure II in the Data Supplement). Aspiration thrombectomy was associated with a non-significant increase in the risk of stroke 0.6% versus 0.4% (RR, 1.45; 95% CI, 0.96–2.21; P=0.08; F=0%; Figure III in the Data Supplement). Aspiration thrombectomy was associated with a higher incidence of complete ST-segment resolution 68% versus 64% (RR, 1.17; 95% CI, 1.08–1.28; P<0.0001; F=66%), and improved myocardial blush grade of ≥2 59% versus 43% (RR, 1.39; 95% CI, 1.19–1.62; P<0.0001; F=84%).

Meta-Regression

Meta-regression analysis did not identify a difference for the log RR of all-cause mortality, reinfarction, the combined outcome of mortality or reinfarction, MACE, complete ST-segment resolution, or TIMI bluss grade ≥2 with the percentage of the glycoprotein IIb/IIIa inhibitors usage (P=0.17, 0.70, 0.58, 0.77, 0.17, and 0.98, respectively). Figures 2 and 3 demonstrate the meta-regression plot for mortality and the combined outcome of mortality or reinfarction with the percentage of the glycoprotein IIb/IIIa inhibitors usage. Figures IV and V in the Data Supplement demonstrate the meta-regression plot for the reinfarction and MACE with the percentage of the glycoprotein IIb/IIIa inhibitors usage. We were not able to conduct a separate meta-regression analysis using the difference in the percentage of glycoprotein IIb/IIIa inhibitors between treatment arms because only 3 trials exhibited a modest difference in the percentage of glycoprotein IIb/IIIa inhibitors usage between arms.26,32,33 Similarly, meta-regression analysis did not identify a difference for the log RR of all-cause mortality, reinfarction, the combined outcome of mortality or reinfarction, MACE, complete ST-segment resolution, and TIMI bluss grade of ≥2 with ischemic time (P=0.29, 0.66, 0.58, 0.16, 0.20, and 0.25, respectively). Figures 4 and 5 demonstrate the meta-regression plot for mortality and the combined outcome of mortality or reinfarction with ischemic time. Figures VI and VII in the Data Supplement demonstrate the meta-regression plot for the reinfarction and MACE with ischemic time. Meta-regression for the outcomes of stent thrombosis and stroke was not possible.

### Table 1. Baseline Characteristics, Follow-Up Duration, and the Primary Outcome of the Included Studies

<table>
<thead>
<tr>
<th>Study (Reference)</th>
<th>Year</th>
<th>Patients (n)</th>
<th>Follow-Up Duration, mo</th>
<th>Mean Time From Symptom Onset Till PCI, h</th>
<th>Primary Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTAL4</td>
<td>2015</td>
<td>5033/5030</td>
<td>6</td>
<td>3.0/2.9*</td>
<td>Composite of cardiac death, recurrent MI, cardiogenic shock, class IV heart failure</td>
</tr>
<tr>
<td>TASTE5</td>
<td>2013</td>
<td>3621/3623</td>
<td>1</td>
<td>3.1/3.0*</td>
<td>All-cause mortality</td>
</tr>
<tr>
<td>TROFI26</td>
<td>2013</td>
<td>71/70</td>
<td>Hospitalization</td>
<td>NR/NR</td>
<td>Myocardial reperfusion markers</td>
</tr>
<tr>
<td>MUSTELA37</td>
<td>2012</td>
<td>50/104</td>
<td>12</td>
<td>3.8/3.5*</td>
<td>Myocardial reperfusion markers and infarct size</td>
</tr>
<tr>
<td>INFUSE-AMI32</td>
<td>2012</td>
<td>229/223</td>
<td>1</td>
<td>2.4/2.7*</td>
<td>Infarct size by MRI</td>
</tr>
<tr>
<td>Cizewski et al38</td>
<td>2011</td>
<td>67/70</td>
<td>Hospitalization</td>
<td>5.6/5.6</td>
<td>Myocardial reperfusion markers</td>
</tr>
<tr>
<td>PHRATE39</td>
<td>2010</td>
<td>100/96</td>
<td>6</td>
<td>NR/NR</td>
<td>Myocardial reperfusion markers</td>
</tr>
<tr>
<td>Listro et al30</td>
<td>2009</td>
<td>55/56</td>
<td>6</td>
<td>3.2/3.5</td>
<td>Myocardial reperfusion markers</td>
</tr>
<tr>
<td>EXPIRA13</td>
<td>2009</td>
<td>88/87</td>
<td>9</td>
<td>6.2/6.1</td>
<td>Myocardial reperfusion markers</td>
</tr>
<tr>
<td>VAMPIRE13</td>
<td>2008</td>
<td>180/175</td>
<td>Hospitalization</td>
<td>6.3/7.1</td>
<td>Myocardial reperfusion markers</td>
</tr>
<tr>
<td>Export22</td>
<td>2008</td>
<td>120/129</td>
<td>1</td>
<td>6.0/5.1</td>
<td>Myocardial reperfusion markers</td>
</tr>
<tr>
<td>Chao et al31</td>
<td>2008</td>
<td>37/37</td>
<td>6</td>
<td>5.6/5.9</td>
<td>Myocardial reperfusion markers</td>
</tr>
<tr>
<td>TAPAS14</td>
<td>2008</td>
<td>535/536</td>
<td>1</td>
<td>3.2/3.1*</td>
<td>Myocardial reperfusion markers</td>
</tr>
<tr>
<td>DEAR-MI44</td>
<td>2006</td>
<td>74/74</td>
<td>Hospitalization</td>
<td>3.4/3.3</td>
<td>Myocardial reperfusion markers</td>
</tr>
<tr>
<td>De Luca et al35</td>
<td>2006</td>
<td>38/38</td>
<td>6</td>
<td>7.2/7.6</td>
<td>Left ventricular remodeling</td>
</tr>
<tr>
<td>Kaitofo et al36</td>
<td>2006</td>
<td>108/107</td>
<td>1</td>
<td>4.0/3.5*</td>
<td>Myocardial salvage by SPECT</td>
</tr>
<tr>
<td>REMEDIA42</td>
<td>2005</td>
<td>50/49</td>
<td>1</td>
<td>4.6/5.0</td>
<td>Myocardial reperfusion markers</td>
</tr>
</tbody>
</table>
because of limited studies available for analysis (several studies were excluded with zero events in a single arm). A separate meta-regression for second generation drug-eluting stents with the individual outcomes also could not be performed because of the limited number of studies reporting this information.

**Discussion**

In this analysis of 17 randomized trials, we demonstrated that aspiration thrombectomy did not significantly reduce the risk of all-cause mortality, reinfarction, the combined outcome of mortality or reinfarction, MACE, or stent thrombosis when compared with conventional PCI. In addition, aspiration thrombectomy was associated with a nonsignificant increase in the risk of stroke. Moreover, the concomitant administration of intravenous glycoprotein IIb/IIIa inhibitors or ischemic time did not influence (ie, reduce) the risk of mortality, reinfarction, the combined outcomes of mortality or reinfarction, MACE, or myocardial reperfusion markers in STEMI patients who underwent aspiration thrombectomy before primary PCI.

We performed a meta-regression to examine the relationship...
Figure 1. Summary plot for all-cause mortality, reinfarction, the combined outcome of mortality or reinfarction, and major adverse cardiac events (MACEs). The relative size of the data markers indicates the weight of the sample size from each study. CI indicates confidence interval; DEAR-MI, Dethrombosis to Enhance Acute Reperfusion in Myocardial Infarction; EXPIRA, Thrombectomy With Export Catheter in Infarct-Related Artery During Primary Percutaneous Coronary Intervention; INFUSE-AMI, Infuse–Acute Myocardial Infarction; MI, myocardial infarction; MUSTELA, Multidevice Thrombectomy in Acute ST-Segment Elevation Myocardial Infarction; PCI, percutaneous coronary intervention; PIHRATE, Polish-Italian-Hungarian Randomized Thrombectomy; REMEDIA, The Randomized Evaluation of the Effect of Mechanical Reduction of Distal Embolization by Thrombus-Aspiration in Primary and Rescue Angioplasty; RR, risk ratio; TAPAS, Thrombus Aspiration During Percutaneous Coronary Intervention in Acute Myocardial Infarction Study; TASTE, Thrombus Aspiration in Myocardial Infarction; TOTAL, Trial of Routine Aspiration Thrombectomy With PCI Versus PCI Alone in Patients With STEMI; TROFI, Randomized Study to Assess the Effect of Thrombus Aspiration on Flow Area in STEMI Patients; and VAMPIRE, Vacuum Aspiration Thrombus Removal.
between intravenous glycoprotein IIb/IIIa inhibitors and the different clinical outcomes. Despite the absence of heterogeneity in clinical outcomes, there was a high degree of variability in the percentage of glycoprotein IIb/IIIa inhibitors usage across the trials. In the majority of the included studies, patients were pretreated with ADP antagonists and in particular clopidogrel. Our findings were limited to intravenous administration of abciximab, except for the Infuse–Acute Myocardial Infarction (INFUSE-AMI) trial, in which abciximab was administered via an intralosomal route by perfusion balloon.

Prior randomized trials and meta-analyses had shown disparate results for the short-term benefits of aspiration thrombectomy; however, none of the studies was designed to address the potential synergistic effect of glycoprotein IIb/IIIa inhibitors on outcomes. In the INFUSE-AMI trial, patients were randomized in a 2x2 factorial design to intralosomal abciximab at the site of the infarct lesion using a special infusion catheter versus no intracoronary abciximab. Patients were also simultaneously randomized to aspiration thrombectomy versus no aspiration thrombectomy. Major adverse cardiac and cerebrovascular events at 1 year were numerically lowest (6.8%) in the group that received intralosomal abciximab and thrombectomy, when compared with 8.5% with aspiration thrombectomy alone, 9.3% with intralosomal abciximab alone, and 11.2% with neither; however, these differences did not achieve statistical significance (P=0.71). A recent study demonstrated that concomitant use of glycoprotein IIb/IIIa inhibitors may have a synergistic effect with aspiration thrombectomy on 30-day mortality. However, that analysis did not include the totality of data. Also, in our meta-regression analysis, we tested our hypothesis against various outcomes and we sought to eliminate potential bias by excluding studies that had zero events in a single arm. The overall results of this meta-analysis differ from prior meta-analyses likely because of the inclusion of a much larger number of patients and events, as well as a greater number of sites and operators, making the results more generalizable. It is not uncommon for initial favorable effects of experimental treatments to be overestimated. It is also possible that concurrent advances in door-to-balloon time and stent technology have reduced thrombotic complications of primary PCI.
Outcomes With Aspiration Thrombectomy

Our study has some limitations. First, the primary outcome for the majority of the included studies was myocardial reperfusion markers and not clinical outcomes. Second, MACE was not uniformly defined among all the studies; however, we also observed no benefit in the outcome of mortality or myocardial infarction. Third, a few studies were excluded in the meta-regression because of no events. Fourth, benefits such as ability to perform direct stenting or reduced stent length were not examined, as we focused on clinical end points.

In conclusion, aspiration thrombectomy before primary PCI was not associated with any clinical benefit and might increase the risk of stroke. Moreover, the coadministration of intravenous glycoprotein IIb/IIIa inhibitors and ischemic time did not seem to influence any potential benefits observed with aspiration thrombectomy.

Disclosures

Dr Bavry: Contractor, American College of Cardiology; Dr Bhatt: Advisory Board; Cardax, Elsevier Practice Update Cardiology, Medscape Cardiology, Regado Biosciences; Board of Directors: Boston VA Research Institute, Society of Cardiovascular Patient Care; Chair: American Heart Association Get With The Guidelines Steering Committee; Data Monitoring Committees: Duke Clinical Research Institute, Harvard Clinical Research Institute, Mayo Clinic, Population Health Research Institute (including for the TOTAL trial); Honoraria: American College of Cardiology (Senior Associate Editor, Clinical Trials and News, ACC.org), Belvoir Publications (Editor in Chief, Harvard Heart Letter), Duke Clinical Research Institute (clinical trial steering committees), Harvard Clinical Research Institute (clinical trial steering committee), HMP Communications (Editor in Chief, Journal of Invasive Cardiology), Journal of the American College of Cardiology (Associate Editor), Population Health Research Institute (clinical trial steering committee), Slack Publications (Chief Medical Editor, Cardiology Today’s Intervention), WebMD (CME steering committees); Other: Clinical Cardiology (Deputy Editor); Research Funding: Amarin, AstraZeneca, Bristol-Myers Squibb, Eisai, Ethicon, Forest Other: Clinical Cardiology (Deputy Editor); Research Funding: Amarin, AstraZeneca, Bristol-Myers Squibb, Eisai, Ethicon, Forest

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Supplemental appendix:

Supplemental Figure 1: Study Selection Flow Diagram.

Supplemental Figure 2: Summary plot for stent thrombosis.

Supplemental Figure 3: Summary plot for stroke.

Supplemental Figure 4: Meta-regression plot for re-infarction with glycoprotein IIb/IIIa inhibitors.

Supplemental Figure 5: Meta-regression plot for major adverse cardiac events with glycoprotein IIb/IIIa inhibitors.

Supplemental Figure 6: Meta-regression plot for re-infarction with ischemic time.

Supplemental Figure 7: Meta-regression plot for major adverse cardiac events with ischemic time.
Thrombectomy [MeSH] or Thrombus aspiration [All fields] or Thromboaspiration [All fields] n= 4,043

Limited to:
- Humans
- Clinical trials
- Randomized controlled trials

Myocardial infarction [MeSH] n= 148,467

Combined search n= 635

Articles screened n= 108

Articles deleted based on the title review

Relevant articles retrieved from detailed assessment n= 52

Exclusions:
- Unrelated /retrospective /non-randomized studies, n= 25
- Long term follow-up studies, n= 4
- Study design, n= 4
- Clinical outcomes not reported, n= 1
- Glycoprotein IIb/IIIa inhibitors usage not reported, n= 1

Included in the final analysis n= 17

Supplementary Figure 1: Study Selection Flow Diagram.
Supplementary Figure 2: Summary plot for stent thrombosis. The relative size of the data markers indicates the weight of the sample size from each study. CI=confidence interval; RR=risk ratio

Aspiration thrombectomy associated with lower incidence of stent thrombosis

Aspiration thrombectomy associated with increased incidence of stent thrombosis

<table>
<thead>
<tr>
<th>ID</th>
<th>RR (95% CI)</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTAL</td>
<td>0.88 (0.65, 1.20)</td>
<td>81.12</td>
</tr>
<tr>
<td>TASTE</td>
<td>0.47 (0.21, 1.05)</td>
<td>11.97</td>
</tr>
<tr>
<td>TROFI</td>
<td>2.96 (0.12, 71.41)</td>
<td>0.74</td>
</tr>
<tr>
<td>INFUSE-AMI</td>
<td>2.92 (0.31, 27.87)</td>
<td>1.48</td>
</tr>
<tr>
<td>Liistro et al</td>
<td>0.51 (0.05, 5.45)</td>
<td>1.33</td>
</tr>
<tr>
<td>VAMPIRE</td>
<td>0.32 (0.01, 7.90)</td>
<td>0.74</td>
</tr>
<tr>
<td>TAPAS</td>
<td>0.50 (0.09, 2.72)</td>
<td>2.62</td>
</tr>
<tr>
<td>EXPIRA</td>
<td>(Excluded)</td>
<td>0.00</td>
</tr>
<tr>
<td>Overall</td>
<td>0.82 (0.62, 1.08)</td>
<td>100.00</td>
</tr>
</tbody>
</table>

NOTE: Weights are from random effects analysis
Supplementary Figure 3: Summary plot for stroke. The relative size of the data markers indicates the weight of the sample size from each study. CI=confidence interval; RR= risk ratio

<table>
<thead>
<tr>
<th>Study</th>
<th>RR (95% CI)</th>
<th>Weight %</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTAL</td>
<td>2.06 (1.14, 3.74)</td>
<td>49.65</td>
</tr>
<tr>
<td>TASTE</td>
<td>1.06 (0.56, 2.01)</td>
<td>42.62</td>
</tr>
<tr>
<td>TROFI</td>
<td>0.33 (0.01, 7.93)</td>
<td>1.74</td>
</tr>
<tr>
<td>INFUSE-AMI</td>
<td>0.32 (0.01, 7.93)</td>
<td>1.73</td>
</tr>
<tr>
<td>Kaltoft et al</td>
<td>4.95 (0.24, 101.99)</td>
<td>1.93</td>
</tr>
<tr>
<td>REMEDIA</td>
<td>0.98 (0.06, 15.23)</td>
<td>2.34</td>
</tr>
<tr>
<td>MUSTELA</td>
<td>(Excluded)</td>
<td>0.00</td>
</tr>
<tr>
<td>TAPAS</td>
<td>(Excluded)</td>
<td>0.00</td>
</tr>
<tr>
<td>Overall (I-squared = 0.0%, p = 0.458)</td>
<td>1.45 (0.96, 2.21)</td>
<td>100.00</td>
</tr>
</tbody>
</table>

NOTE: Weights are from random effects analysis

Aspiration thrombectomy associated with lower incidence of stroke

Aspiration thrombectomy associated with increased incidence of stroke
Supplementary Figure 4: Meta-regression plot for the combined outcome of re-infarction with glycoprotein IIb/IIIa inhibitors.
Supplementary Figure 5: Meta-regression plot for the combined outcome of MACE with glycoprotein IIb/IIIa inhibitors.

MACE

Log RR

Glycoprotein IIb/IIIa inhibitors, %
P=0.77
Supplementary Figure 6: Meta-regression plot for re-infarction with ischemic time.
Supplementary Figure 7: Meta-regression plot for MACE with ischemic time.