Should the practicing interventionalist use manual aspiration systematically in all patients or only in selected patients with an angiographically obvious thrombotic burden?

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Abstract

A best-evidence topic in cardiac surgery was written according to a structured protocol. The question addressed was, should the practicing interventionalist use manual aspiration systematically in all patients undergoing percutaneous coronary intervention (PCI) or only in selected patients with an angiographically obvious thrombotic burden? Altogether, 198 papers were found using the reported search, of which nine represented the best evidence to answer the clinical question. The authors, journal, date and country of publication, patient group studied, study type, relevant outcomes and results of these papers are tabulated. We conclude that the evidence demonstrates that clinical and angiographic outcomes with respect to manual thrombectomy are similar and encouraging for patients with both angiographic evidence of thrombus burden and those in whom it is used routinely. In addition, there is no significant increase in major adverse cardiac events when routine use of manual aspiration is adopted as opposed to reserving its use for those patients with angiographic evidence of thrombus. In summary, the evidence supports the use of routine systematic manual aspiration in all patients undergoing primary PCI for ST-elevation myocardial infarction.

Keywords: Manual aspiration • Percutaneous coronary intervention • Angiographically thrombotic burden • Cardiology • Coronary angiography • Thrombosis • Heart diseases • Thrombectomy • Review

INTRODUCTION

A best-evidence topic was constructed according to a structured protocol. This is fully described in the ICVTS [1].

THREE-PART QUESTION

In patients [undergoing percutaneous coronary intervention] is [routine systematic manual aspiration superior] to [manual aspiration carried out only in those patients with angiographically obvious thrombotic burden]?

CLINICAL SCENARIO

You are a cardiac surgeon at the local cardiothoracic multidisciplinary meeting when a colleague, an interventional cardiologist, presents a complex case involving a patient with a ST-elevation myocardial infarction (STEMI). It is noted by the clinical director of your department that prior to treatment of the index patient, the cardiologist used a manual thrombectomy device to retrieve the clot despite there being no angiographically obvious thrombotic burden. He states it is a ludicrous practice to perform unnecessary interventions and that it should only be carried out if there is a visible thrombus that can be removed. The presenting cardiologist, taken aback, refutes the comment, stating that he uses manual aspiration for every STEMI case regardless of whether he can see an angiographically obvious thrombotic burden within the culprit vessel; he claims that in his experience, it improves his patient outcomes. A heated debate ensues with claims that this practice harks back to the dark days prior to evidence-based medicine and that there is no solid evidence base to support this practice. You resolve to check the literature yourself.

SEARCH STRATEGY

<table>
<thead>
<tr>
<th>Author, date, journal and country, Study type (level of evidence)</th>
<th>Patient group</th>
<th>Outcomes</th>
<th>Key results</th>
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<tbody>
<tr>
<td>Dudek et al. (2010), Am J Cardiol, Poland, Italy, Hungary</td>
<td>This study enrolled 196 patients with STEMI, who were referred pPCI. Unselected patients with STEMI were randomized to either standard PCI or PCI with manual thrombectomy using the Diver CE (Invatec, Brescia, Italy), within 6 h from chest pain onset Routine use of thrombus aspiration occurred regardless of visualization of thrombus at angiography</td>
<td>STR ≥ 70% assessed 60 min after pPCI</td>
<td>Thrombectomy vs PCI only a trend was observed towards better STR (53.7 vs 35.1%, ( P = 0.29 ))</td>
<td>This multicentre RCT showed that using manual aspiration thrombectomy routinely improved combined MBG and TIMI flow in comparison with PCI alone. It was not powered sufficiently to detect benefits in mortality or reinfarction rate</td>
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<tr>
<td>Svilaas et al. (2008), N Engl J Med, Netherlands</td>
<td>This study enrolled 1071 patients with STEMI and randomized patients either to manual aspiration thrombectomy using the Export Medtronic device (Medtronic, Inc., Minneapolis, MN, USA) before PCI or conventional PCI with balloon angioplasty followed by stenting. Of note, 51.4% of those randomized in the thrombectomy arm did not have visible thrombus on angiography at baseline</td>
<td>Post-procedural frequency of a MBG of 0 or 1</td>
<td>17.1% of patients with thrombus aspiration and 26.3% of those with conventional PCI, ( P &lt; 0.001 )</td>
<td>This RCT showed a trend towards improved mortality at 30 days and improvement in myocardial revascularization when PCI was combined with mechanical thrombectomy and that its routine use in patients with STEMI was beneficial</td>
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<td>Vlaar et al. (2008), NEJM, Netherlands</td>
<td>Following on from the previous TAPAS study (Svilaas et al. [4]) a review of reinfarction and death at 1 year was performed</td>
<td>Complete resolution of ST-segment elevation</td>
<td>STR occurred in 56.6 and 44.2% (( P &lt; 0.001 )), thrombectomy and PCI vs PCI only, respectively</td>
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<td>Cardiac death at 1 year</td>
<td>Death at 30 days</td>
<td>Thrombectomy and PCI 11/529 (2.1%) and PCI only 21/531 (4.0%) (risk ratio, 0.52; 95% CI, 0.26–1.07; ( P = 0.07 )), not significant</td>
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<td>Cardiac death and non-fatal reinfarction at 1 year</td>
<td>Reinfarction at 30 days</td>
<td>Thrombectomy and PCI 4/529 (0.8%) and PCI only 10/531 (1.9%) (risk ratio, 0.40; 95% CI, 0.13–1.27; ( P = 0.11 )), not significant</td>
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This RCT showed that the use of manual thrombus aspiration before stenting during pPCI results in a lower cardiac mortality and a lower incidence of the cardiac death or non-fatal reinfarction.
Table 1: (Continued)

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<td>Burzotta et al. (2005), J Am Coll Cardiol, Italy [3] Randomized controlled trial (level 2)</td>
<td>99 patients were enrolled into this study which compared manual aspiration thrombectomy using the Diver CE (Invatec, Brescia, Italy) preintervention against standard PCI in unselected patients with STEMI. Forty-eight patients were randomized to receive thrombectomy</td>
<td>Post-procedural rates of MBG ≥ 2</td>
<td>Thrombectomy vs standard PCI 68 vs 44%, respectively. Odds ratio 2.6 (95% CI 1.2–5.9), ( P = 0.020 )</td>
<td>This RCT demonstrates that use of manual aspiration thrombectomy in unselected STEMI patients undergoing pPCI is feasible and has clinical benefit with regards to increased myocardial perfusion and clinical outcomes</td>
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<td>Silva-Orrego et al. (2006), J Am Coll Cardiol, Italy [7] Randomized controlled trial (level 2)</td>
<td>This trial randomized 148 unselected patients with STEMI independent of angiographic evidence of thrombus to receive either pPCI or pPCI with initial thrombus aspiration using the Pronto aspiration extraction catheter (Vascular Solutions, Minneapolis, MN, USA). Inclusion criteria included TIMI flow 0/1 or visible thrombus</td>
<td>STR ≥ 70%</td>
<td>Thrombectomy vs standard PCI P = 0.025</td>
<td>No statistically significant difference between the two groups</td>
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<td>Sardella et al. (2010) Am J Cardiol, Italy, UK [9] Randomized controlled trial (level 2)</td>
<td>The EXPIRA study investigated whether manual thrombectomy in pPCI was superior to PCI only in 175 patients with STEMI and angiographic evidence of a thrombus burden. The device used was the Export Medtronic device (Medtronic, Inc.)</td>
<td>Final MBG ≥ 2</td>
<td>Thrombectomy vs standard PCI; 88 vs 59%, ( P &lt; 0.0001 )</td>
<td>This study demonstrates that improved myocardial perfusion and resolution in ST segment changes can be achieved with manual thrombectomy when compared with standard PCI</td>
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### RESULTS

In total, 198 papers were found using the reported search. From these, nine papers were identified that provided the best evidence to answer the question. These are presented in Table 1.

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<td>Sardella et al. (2010), Am J Cardiol, Italy, UK [9]</td>
<td>In this follow-up, results were analysed for cardiac death at 9 months and 2 years</td>
<td>Cardiac death at 9 months and 2 years</td>
<td>At 9 months: standard PCI vs PCI and thrombectomy, 4.6 vs 0.0%, ( P = 0.023 )</td>
<td>This study demonstrates that in patients with angiographic evidence of thrombus burden it outcomes at both 9 months and 2 years are improved if pretreatment with manual aspiration is performed instead of a standard PCI strategy. It also demonstrates that there are no greater numbers of MACE when compared with standard therapy</td>
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<td>Margheri et al. (2007), J Interv Cardiol, Italy [8]</td>
<td>129 consecutive patients with angiographic evidence of thrombus underwent thrombectomy using Export Medtronic device (Medtronic, Inc.) followed by PCI. An historical STEMI control group from the same institution were used as a control</td>
<td>Corrected TIMI frame count (cTFC) vs control</td>
<td>Difference in cTFC from baseline to post-balloon dilation: 66 ± 36 for those treated with EXPORT vs 41 ± 37 for those not treated with thrombus aspiration, ( P &lt; 0.001 )</td>
<td>This study showed that use of manual thrombectomy was associated with significant improvements in TIMI flow when compared with standard PCI. However, it was not powered to detect mortality benefits</td>
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<td>Ciszewski et al. (2011), Catheter Cardiovasc Interv, Poland [6]</td>
<td>This study prospectively randomized 137 patients to either aspiration thrombectomy with RESCUE catheter (Boston Scientific/Scimed) and the Diver CE (Invatec, Brescia, Italy), followed by PCI with stent implantation or to standard PCI with stent implantation. All patients randomized had a thrombus score of ≥3 according to TIMI guidelines</td>
<td>The primary endpoint was MSI as assessed by sestamibi SPECT imaging</td>
<td>Thrombectomy group: 25.4% (IQR 13.5–44) vs 18.5% (IQR 7.7–30.3) in the pPCI group, ( P = 0.02 )</td>
<td>This study demonstrates that in patients with angiographic evidence of high thrombus burden, mechanical thrombectomy is clinically beneficial and increases the volume of myocardium salvaged when compared with standard PCI and stenting strategies</td>
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**SEARCH OUTCOME**

In total, 198 papers were found using the reported search. From these, nine papers were identified that provided the best evidence to answer the question. These are presented in Table 1.

**RESULTS**

Dudek et al. [2] found that in STEMI patients who undergo routine manual systematic aspiration of thrombus against a standard percutaneous coronary intervention (PCI) strategy, there is an improvement in myocardial perfusion as assessed by myocardial blush grade (grade 3 rates 76.1 vs 57.8%, respectively, \( P = 0.026 \)). A similar improvement in myocardial perfusion was found by Burzotta et al. [3] in their study of individuals with STEMI treated with manual thrombectomy and PCI or PCI alone (68 vs 44%, respectively [odds ratio 2.6, 95% confidence interval (CI) 1.1–6.2, \( P < 0.025 \)]. Svilas et al. [4] found, in their study of 1071 STEMI patients, that routine manual thrombectomy and PCI significantly reduced the number of cases with a post-procedural MBG of 0/1 when compared with standard PCI alone (17.1 vs 26.3%,
respectively, \( P < 0.001 \). Encouragingly, the results obtained in these studies are comparable with those found by Sardella et al. [5] in patients with angiographic evidence of thrombus undergoing manual thrombectomy and standard PCI against PCI only (88 vs 59%, respectively, \( P < 0.0001 \)).

Ciszewski et al. [6] measured the myocardial salvage index (MSI) using septamibi single photon emission computed tomography in their study of 137 patients with a visible thrombus on angiogram who underwent either manual thrombectomy or PCI only. They found that there was a significant increase in the MSI in the thrombectomy arm in comparison with the standard PCI arm [25.4% (IQR 13.5–44) vs 18.5% (IQR 7.7–30.3), respectively, \( P = 0.02 \)].

Burzotta et al. [3], Silva-Orrego et al. [7] and Svilas et al. [4] studied the effects of routine manual thrombus aspiration in all individuals prior to PCI against a standard PCI strategy and its effects on ST segment resolution (STR) in the immediate aftermath of the procedure. Their sets of results, for a patient population totalling 1318 show similar improvements: Burzotta et al. [3][58 vs 36.7% (odds ratio 2.4; 95% CI 1.1–5.3), \( P = 0.034 \)], Silva-Orrego et al. [7] [68 vs 50%; \( P < 0.05 \)] and Svilas et al. [4] [56.6 and 44.2%, \( P < 0.001 \)], for mechanical thrombectomy vs PCI alone. The results of immediate ST resolution in all individuals are similar to those obtained in the study by Sardella et al. [5] who assessed mechanical thrombectomy against standard PCI strategies in only those patients with angiographic evidence of visible clot burden. They found that resolution was achieved in 63 vs 39% (\( P < 0.001 \)) for thrombectomy patients against the use of standard PCI, respectively.

Ciszewski et al. [6] showed that in their study of 137 patients with angiographic evidence of thrombus load undergoing manual thrombectomy against standard PCI, in-hospital mortality did not differ significantly, 3 vs 4% (\( P = 1.0 \)) for thrombectomy vs standard PCI, respectively. A similar patient mortality rate of 4.5% from cardiac death following selective manual aspiration was found by Margheri et al. [8] in 129 consecutive patients treated with the Export catheter device.

Dudek et al. [2] found that in patients undergoing routine manual aspiration vs those undergoing standard PCI strategies, periprocedural complications were not significantly different between the two interventions (16 and 24.2%, respectively, \( P = 0.15 \)). Burzotta et al. [3] and Silva-Orrego et al. [7] found there were no significant differences in the numbers of patients suffering early major adverse cardiovascular events (reinfarction, left ventricular failure and target vessel revascularization) between patients undergoing routine manual aspiration of thrombus and PCI and standard PCI treatment alone.

Sardella et al. [9] showed that in patients with a visible thrombus on angiogram cardiac death at 9 months and 2 years was 4.6% for standard PCI vs 0.0% for thrombectomy, (\( P = 0.023 \)) and 6.8% for standard PCI vs 0.0% for thrombectomy, \( P = 0.012 \) respectively. This is a result similar to that found by Sardella et al., but in the case of STEMI patients undergoing routine manual aspiration and PCI vs those undergoing PCI only, Vlaar et al. [10] found a reduction in cardiac death at 1 year that was significant (3.6 vs 6.7% for thrombectomy vs standard PCI, respectively, hazard ratio 1.93, 95% CI 1.11–3.37, \( P = 0.020 \)).

**CLINICAL BOTTOM LINE**

The evidence demonstrates that clinical and angiographic outcomes with respect to manual thrombectomy are similar and encouraging for both patients with angiographic evidence of thrombus burden and those in whom it is used routinely. In addition, there is no significant increase in major adverse cardiac events (MACE) when routine use of manual aspiration is adopted as opposed to reserving its use for those patients with angiographic evidence of thrombus. In summary, the evidence supports the use of routine systematic manual aspiration in all patients undergoing primary PCI for STEMI. It is important to note that two large randomized trials involving in excess of 4000 patients each led by Frobert et al. [11] (TASTE trial) and Jolly and Džavk (TOTAL trial) [12] are investigating this particular clinical question and are due to report in 2014.

**Conflict of interest:** none declared.

**REFERENCES**


