Primary PCI: should we stent every single culprit artery?

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Abstract
In four selected patients presenting with ST-segment elevation myocardial infarction (STEMI), aspiration thrombectomy allowed for full filling defect angiographic ‘cleaning’ of the culprit arteries without need for stent implantation. Obtaining good angiographic results and uneventful early and long-term clinical outcome after thrombus aspiration alone raises the question as to whether stenting the infarcted thrombotic artery is mandatory and routinely indicated in every single STEMI patient treated with primary percutaneous coronary intervention.

Keywords
Acute coronary syndrome, aspiration thrombectomy, coronary reperfusion, primary percutaneous coronary intervention, ST-segment elevation myocardial infarction

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Introduction
Primary percutaneous coronary intervention (PCI) is the optimal reperfusion therapy for instead of in patients with ST-segment elevation myocardial infarction (STEMI).1 In an effort to reduce cardiac adverse events and mortality rate,2 based on The Thrombus Aspiration during Percutaneous Coronary Intervention in Acute Myocardial Infarction Study (TAPAS) reporting reduced mortality at 1-year post infarction, aspiration thrombectomy has gained widespread clinical acceptance. More recently, however, the relatively expanded use of aspiration has been attenuated as emerging prognostic uncertainties cast doubt on the utility of aspiration in STEMI patients.3,4 Taking into consideration safety versus efficacy as well as acknowledging the unproven benefit of aspiration, the routine use of aspiration was put forth as class IIa recommendation, level of evidence B, by both the European Society and the American College of Cardiology/American Heart Association.5,6

The underlying mechanism involved in acute infarction involves plaque rupture and thrombus formation. Reducing the thrombotic burden which could be an imminent source of a distal embolization and for a non-reflow phenomenon with its deleterious implications is intuitively rational and warranted.7 However, despite of the nearly ubiquitous presence of thrombus-containing lesions, the largest trial performed to date among 7244 STEMI patients randomly assigned to thrombus aspiration followed by PCI or PCI only,8 has shown that the use of aspiration as an adjunct to primary PCI has no significant effect on 30-day mortality.

Following thrombus aspiration, we aim to obtain an optimal angiographic result by stenting the culprit lesion with the premise of a 1–2% rate of stent thrombosis.9 In clinical practice, the thrombotic load is extremely variable and the tendency towards stent thrombosis may be higher in patients with a large thrombotic load despite adequate preventive pharmacotherapy.10 Although aspiration failed to yield prognostic benefit, in the high-risk patients presenting with significant thrombotic burden, one may raise the questions as to whether reperfusion achieved by aspiration thrombectomy is at least as important as stenting in restoring coronary flow and whether we should routinely

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stent the thrombotic artery in every single patient undergoing primary PCI.

We present four cases of STEMI patients in whom aspiration thrombectomy allowed for an optimal angiographic results without the need for stent implantation.

A total of 172 patients presented with STEMI underwent primary PCI during a 30-month period. Sixty-eight (39.5%) were managed with aspiration thrombectomy. Target lesion stenting was performed in 163 patients (95%) and in 61 patients (91%) primarily treated with aspiration. No stents were deployed in the four described cases. Technical aspects avoided stent deployment in two more patients. Three other patients presented with acute stent thrombosis were successfully treated by aspiration and balloon dilatation.

Case 1

A 51-year-old male, hypertensive, dyslipidaemic, smoker patient with known coronary artery disease, previous non-STEMI and PCI, was admitted within 2 h of evolving STEMI. ECG was compatible with posterolateral infarction. The patient was treated by unfractionated heparin and dual antiplatelet drugs and referred for primary PCI. As shown in Figure 1, angiography demonstrated a patent anterior descending artery and a thrombotic plaque in a proximal segment of a large intermediate artery. Two distal branches taking off from the intermediate as a Y-shape anatomy were occluded with haziness appearance suggesting distal embolization. The patient was placed on 2b/3a inhibitors. A guide wire was advanced to one of the branches. An aspiration device (Pronto; Vascular Solutions) was placed at the ‘carina’ of the two emerging branches removing two strips of thrombotic material. Subsequent angiogram revealed full opacification of the two branches with TIMI grade 3 flow. A stent was implanted at the proximal thrombotic lesion only with good angiographic results. One-year clinical follow up was uneventful, including a normal perfusion scan.

Case 2

A 44-year-old smoking dyslipidaemic woman came with 90 min of chest pain. ECG revealed ST-segment elevation in leads 2, 3, and avF with reciprocal changes. She was primarily treated as in case 1. As shown in Figure 2, angiography revealed 2-vessel disease including a mid left anterior descending arterial narrowing and a critical occlusive lesion with filling defect of the distal right coronary artery. The patient was placed on 2b/3a inhibitors. An aspiration device, placed adjacent to the proximal occlusive lesion, was advanced towards the distal segment exposing a conglomerate of thrombotic material. Subsequent injection demonstrated a TIMI grade 3 flow, good myocardial blush, and a fully patent artery and its emerging branches. No further intervention was indicated. Antiplatelets and dyslipidaemic drugs were started. A noninvasive assessment was entirely normal in all territories. At 9 month follow up, she remained symptom free.

Case 3

A 36-year-old smoking woman was admitted with STEMI anterior wall. She was referred for primary PCI, 2 h from symptoms onset. Family history was remarkable for antiphospholipid antibodies. She was primarily treated as in case 1, including aspirin and prasugrel. As shown in Figure 3, angiography showed single-vessel disease consisting of total left anterior descending arterial occlusion. To enable aspiration, a guidewire insertion was followed by a predilatation using 1.5-mm balloon. The patient was placed on 2b/3a antagonists and an aspiration device was...
placed proximal to the occlusive lesion. Advancing the catheter across the thrombotic lesion gave rise to few thrombotic particles. Final injection showed a fully patent artery with TIMI grade 3 flow and good myocardial blush. ST-segment deviation was resolved and the patient was referred symptom free to the coronary care unit. Six-month follow up was uneventful. A complete haematology work up was negative for thrombophilia.

**Case 4**

A 67-year-old hypertensive woman with a history of rheumatic heart disease who underwent a prosthetic mechanical aortic valve replacement, referred with posterior-wall STEMI. ECG revealed sinus rhythm with ST-segment displacement involving the posterior leads (V7–V9) and reciprocal changes in L3 and AVF. Medical history was notable for a normal coronary angiogram prior to her valve surgery.

**Figure 2.** Case 2: (A) Selective angiography of right coronary artery showing a dominant vessel with critical narrowing of its distal segment (arrow). (B) Repeat angiography following aspiration of thrombotic material demonstrating successful reopening of the vessel with patent posterior branches.

**Figure 3.** Case 3: Left coronary angiogram of an occluded mid left anterior descending artery before (A) and after (B) successful reperfusion by balloon predilatation and thrombus aspiration.
and paroxysmal atrial fibrillation. She was on chronic treatment of Syntrum, and International Normalized Ratio (INR) upon admission was 2.5 units. The patient was preloaded with 300 mg aspirin and 600 mg clopidogrel and transferred for primary PCI 2 h from symptoms onset. As shown in Figure 4, angiography demonstrated an occluded left circumflex artery. Few rounds of aspiration obtained a large thrombotic red mass. This resulted in full opacification of the artery and normalization of ST-segment. Subsequent transoesophageal echocardiography demonstrated a normal functioning valve with no evidence of valvular source of embolism. Four-month follow up was uneventful.

Discussion

These cases provide little body of evidence in favour of aspiration thrombectomy with or without balloon predilation as a stand-alone reperfusion approach in selected cases of primary PCI. In these cases, aspiration thrombectomy provided a ‘stent like result’, namely an angiographic outcome similar to that seen after conventional stenting, resulted in effective clinical and angiographic reperfusion in these STEMI patients. One could argue for treating these thrombotic lesions using either drug eluted or bare metal stents, according to the current practice. On the other hand, it is possible that in selected cases the conventional use of stents may not be routinely required, especially when a large thrombus burden appears to play a crucial role and aspiration yields good angiographic and clinical results.

In this scenario of primary PCI when no stent is placed after optimal reperfusion and thrombus aspiration, one may speculate that an incremental rate of late vessel restenosis may be encountered later on.\textsuperscript{11} In the long run, invisible residual thrombi may promote vessel restenosis, raises concerns about the late clinical outcome in this subset of patients. However, it may be preferable to tackle late native vessel restenosis if it occurs rather than instent restenosis, with its therapeutic complexity and relatively unfavourable long-term results. It is needless to mention the most worrisome harmful complications of stent thrombosis with both bare metal and drug eluted stents.\textsuperscript{12,13} As stated earlier, the TASTE trial\textsuperscript{8} was negative in terms of prognosis but at the same time, a clear reassuring trend was seen in secondary end points of stent thrombosis and rehospitalization. In fact, it has been shown that culprit sites in acute myocardial infarction patients show a greater delay in vascular healing, with evidence of persistent fibrin deposition and incomplete stent strut coverage as compared with culprit arteries of patients with stable angina.\textsuperscript{14} The potential advantages of leaving a stent-free artery, especially with the availability of new potent antiplatelet agents, may counterbalance the routine strategy of stenting every single culprit plaque, no matter what complexity the lesion is, its anatomy, the thrombotic burden, and the propensity towards adverse events and whether the underlying substrate for acute thrombosis may be different like coronary embolization rather than typical plaque rupture.

Another confounding issue relates to the fact that the presence of a plaque that has already ruptured does not necessarily imply that this site is still vulnerable and active. Thus, for patients who may require a bypass surgery after successful primary PCI, obtaining a reasonable angiographic result omit: solely by aspiration alone or combined with a balloon angioplasty and leaving a stent-free target vessel may have a long-lasting beneficial effect, restricting the early risk of bleeding episodes and eliminating the risks of late stent thrombosis and the need for dual antiplatelet therapy. The same thought is valid when treating a patient with known

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\textbf{Figure 4.} Case 4: Left coronary angiography showing an occluded left anterior descending (A) with complete opacification of the artery following thrombus aspiration (B).
history of adverse bleeding episodes or a patient with coagu-
lopthy who does need anticoagulants.

Although we report only four patients, these intriguing
findings which strongly support thrombus aspiration prior to
mechanical intervention are likely to be more common than
generally thought. In our laboratory, we observed similar cases
of acute stent thrombosis where aspiration with or without bal-
loon dilatation yielded optimal angiographic results.

Noteworthy that this was also seen in a minority of patients
undergoing early angiography to assess patency rates follow-
ing fibrinolytic therapy given for acute myocardial infarction.

The question of whether the uncovered plaque should be
stented after successful thrombus aspiration is crucial for
management decisions. Although provisional stenting
remains the main stream policy, we and others believe
that, not only in terms of vessel patency but in terms of
lesion morphology, certain patients undergoing primary PCI
may derive benefit from a stent-free artery. A recent study
from four expert centres applied optical coherence tomogra-
phy to assess plaque morphology, Prati et al. studied 31
STEMI patients who underwent coronary angiography 12 h
from symptoms onset. Twelve patients were managed with
thrombectomy only whereas 19 managed by aspiration and
stenting. In all cases, tomography was compatible with
plaque erosion rather than plaque rupture, supporting the
notion that lesions with an intact fibrous cap and restored
vessel patency can be treated ‘conservatively’, namely
thrombus extraction only. This approach stems from the fact
that erosive lesions are often devoid of a necrotic core and
an angiographic finding of thrombus formation does not
necessarily imply plaque rupture. Therefore, in this context
of findings, an interventional strategy sparing balloon dil-
ation and or stent deployment should be considered.

To guide whether the vulnerable plaque should be
stented, technological advances have made the distinction
between plaque rupture and plaque erosion possible. To
better understand the prognostic significance of this under-
lying pathological finding, combined angiographic-imaging studies should explore this new technology with
respect to early and long-term clinical outcome. Restoring
vessel patency and clinical stability by aspiration thrombec-
tomy only, one may revise this strategy 48–72 h later on
while the patient is on intense antiplatelet therapy. It is not
inconceivable that angiographic findings observed at the
acute phase do not persist, thus obviating the need for stent
deployment and sparing potentially high-risk procedures
within a highly thrombotic milieu.

In conclusion, these case descriptions raise the question
of whether stent deployment may be not routinely applied
in STEMI patients undergoing primary PCI where a large
thrombus burden is evident and aspiration yields good
angiographic results. Some questions remain open, how-
ever, longer term clinical and angiographic follow up will
determine whether these clinically driven observations are
durable over time. Improving clinical and angiographic
results by therapeutic regimens and by optimizing throm-
bus extraction techniques, as well as gaining further observ-
utional insights by future research involving optical
coherence tomography, may consolidate reperfusion strate-
gies in STEMI patients. Meanwhile, decisions with regards
to the optimal management of STEMI patients undergoing
primary PCI should be taken with caution, based on angi-
ographic findings and individual risk stratification.

Conflicts of interest

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