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Case Report

The 'MAP strategy' (Maximum aspiration of atherothrombus and adjunctive glycoprotein IIb/IIIa inhibitor utilization combined with prolonged inflation of balloon/stent) for preventing no-reflow in patients with ST-segment elevation myocardial infarction undergoing percutaneous coronary intervention: A retrospective analysis of seventy-one cases

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ABSTRACT

'No-reflow' phenomenon is a common occurrence in percutaneous coronary intervention (PCI). A three-component 'MAP strategy' was designed to prevent no-reflow by addressing both intralésional and intraluminal thrombus in patients with ST-segment elevation myocardial infarction (STEMI). In this analysis, we observed Thrombolysis In Myocardial Infarction (TIMI) flow grade 3 or 2 in all patients, with no incidence of no-reflow. Myocardial blush grade (MBG) 3 or 2 was observed in most (87.32%) patients. Left ventricular ejection fraction (LVEF) was improved, without any incidence of death up to 9-month follow-up. All patients safely tolerated the strategy-driven prolonged, 35-s inflation of the balloon/stent.

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1. Introduction

Several thrombotic complications accompany percutaneous coronary intervention (PCI), one of which is the no-reflow phenomenon, defined as inadequate myocardial perfusion

without any evidence of mechanical obstruction in a sufficiently dilated coronary vessel. No-reflow is associated with poor outcomes and a novel 'MAP strategy' was designed to prevent it. 'MAP' implies (i) Maximum aspiration of atherothrombus, (ii) Adjuvant utilization of GP IIb/IIIa inhibitor, and (iii) Prolonged inflation of the balloon/stent. This study is a

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retrospective analysis of 71 cases, who underwent 'MAP'-guided PCI for ST-segment elevation myocardial infarction (STEMI), between February 2008 and January 2009.

2. Methods

2.1. Patient population

The study group belonged to three clinical subsets – primary PCI (PPCI), defined as angioplasty without prior or concomitant fibrinolytic therapy [performed within 12 h of STEMI]; pharmacoinvasive PCI, performed with a pharmacological reperfusion treatment delivered prior to the planned PCI in order to bridge the PCI-related time delay [PCI performed within 24 h of STEMI]; and third, patients with ongoing chest pain and nonresolution of ST-segment elevation (STE) despite fibrinolytic therapy, who were referred to the center more than 24 h after STEMI [PCI performed within 72 h of STEMI].

Inclusion criteria were (i) ST elevation of >2 mm in ≥ 2 consecutive leads, and (ii) presentation to the catheterization lab within 24 h [for subset one and two], or within 72 h [for subset three] of STEMI. Exclusion criteria were (i) duration of presentation >72 h, (ii) left main coronary artery thrombosis, (iii) TIMI grade 3 flow on initial angiogram, (iv) extensive triple-vessel disease, and (v) heavily calcified lesion.

2.2. Thrombus aspiration, pharmacotherapy, and stent implantation

PCI was performed using standard techniques; femoral approach was used. A loading dose of clopidogrel (300 mg) and aspirin (350 mg) was administered on admission. Unfractionated heparin (100 units/kg) and tirofiban bolus ($0.4 \mu\text{g}/\text{kg}/\text{min}$) for 30 min, followed by an infusion ($0.15 \mu\text{g}/\text{kg}/\text{min}$) for 12 h, were administered during the procedure.

Multiple passes (minimum two) of thrombus aspiration were carried out, using a 6F thrombuster aspiration catheter (Kaneka Medix, Japan) or 6F Export aspiration catheter (Medtronic, Danvers, USA) (Fig. 1). Predilatation was carried

out if needed by inflating the balloon quickly till disappearance of the waist, keeping it inflated at 1–2 atm higher for 35 s, and later deflating it quickly. The balloon diameter was 0.5 mm less than the vessel diameter. Stents lesser than 20 mm in length were deployed at 14–18 atm. When residual stenosis was $\geq 20\%$, or when stents of ≥ 20 mm length were used, postdilatation with 10–12 mm length balloon was carried out at 14–18 atm. Prolonged (35-s) inflation of stent was done only in case of direct stenting.

2.3. Measurement of endpoints

Patients' angiographic (TIMI flow grade and MBG), electrocardiographic (ECG), echocardiographic (LVEF), and clinical assessments were done. Previous definitions of TIMI flow grade¹ and MBG² were used. A 12-lead electrocardiogram (ECG) was recorded just before, 6 h after, and 24 h after, the procedure. Two-dimensional echocardiography was performed prior to the procedure, at the time of discharge, and at 9-month follow-up. Follow-up data were obtained at the end of 1, 3, and 9 months after the procedure.

3. Results

The mean $[\pm\text{SD}]$ patient age was 58.3 ± 12.0 years. Most patients belonged to either the primary [31 (43.66%) patients] or the pharmacoinvasive [33 (46.48%) patients] subsets. The mean door-to-balloon time in PPCI was 290 min.

Following the 'MAP strategy', no patient showed TIMI grade 0 or 1 flow (no-reflow) (Table 1). Successful reperfusion (MBG 3 or 2) and significant STE recovery ($>50\%$ ST-segment resolution (STR)) were achieved in 62 (87.32%) and 51 (71.83%) patients, respectively (Table 2). The mean $(\pm\text{SD})$ LVEF measured by two-dimensional echocardiography improved by 6.76–50.56% ($\pm 8.68\%$) at 9-month follow-up.

Two patients had minor dissections during aspiration, which were tackled by the stent. Other than a case of congestive cardiac failure after 6 months, no complications, such as reinfarction, and angina requiring revascularization at months 1, 3, and 9, were reported. Neither death nor rehospitalization was reported up to the 9-month follow-up.

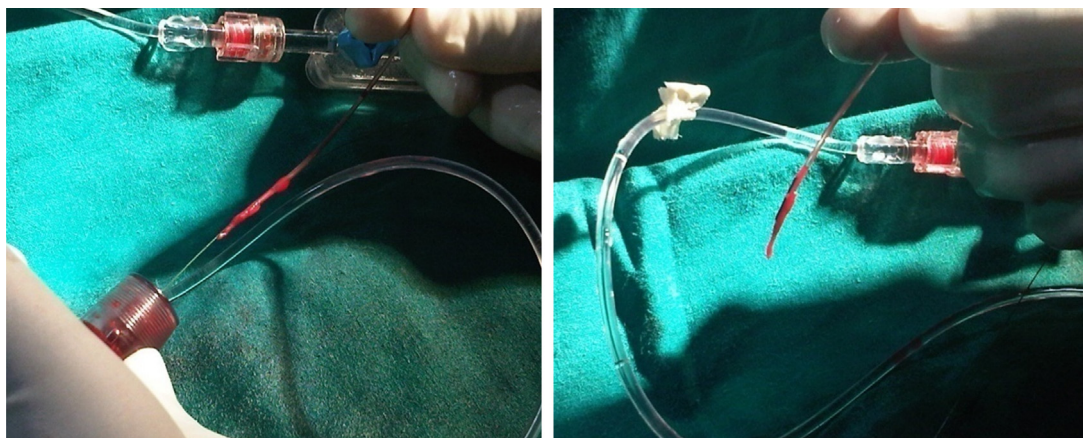


Fig. 1 – Aspirated clot hanging free from aspiration catheter tip.

Table 1 – TIMI flow grades pre- and post-PCI.

| Type of PCI | Pre-PCI TIMI flow grade | | Post-PCI TIMI flow grade | |
|--|----------------------------|------------|----------------------------|------------|
| | Number of patients [n (%)] | | Number of patients [n (%)] | |
| | | | TIMI 2 | TIMI 3 |
| Primary | TIMI 0 | 13 (41.94) | 2 (6.45) | 11 (35.48) |
| | TIMI 1 | 11 (35.48) | – | 11 (35.48) |
| | TIMI 2 | 7 (22.58) | – | 7 (22.59) |
| | Total | 31 (100) | 2 (6.45) | 29 (93.55) |
| Pharmacoinvasive | TIMI 0 | 1 (3.03) | – | 1 (3.04) |
| | TIMI 1 | 17 (51.52) | 2 (6.06) | 15 (45.45) |
| | TIMI 2 | 15 (45.45) | – | 15 (45.45) |
| | Total | 33 (100) | 2 (6.06) | 31 (93.94) |
| Symptomatic patients up to 72 h ^a | TIMI 0 | 5(71.43) | 4 (57.14) | 1 (14.29) |
| | TIMI 1 | 2 (28.57) | – | 2 (28.57) |
| | TIMI 2 | – | – | – |
| | Total | 7 (100) | 4 (57.14) | 3 (42.86) |
| All | TIMI 0 | 19 (26.76) | 6 (8.45) | 13 (18.31) |
| | TIMI 1 | 30 (42.25) | 2 (2.82) | 28 (39.44) |
| | TIMI 2 | 22 (30.99) | – | 22 (30.98) |
| | Total | 71 (100) | 8 (11.27) | 63 (88.73) |

PCI = percutaneous coronary intervention; TIMI = Thrombolysis In Myocardial Infarction.

^a These patients were referred to the study center more than 24 h after STEMI, with failed thrombolysis. PCI was done within 72 h.

Table 2 – TIMI flow grades and ST-segment resolution based on grouped myocardial blush grades.

| MBG | Number of patients [n (%)] | | | | |
|--------|----------------------------|----------------------------|----------------------------|--------------------|--------------------|
| | Total | Post-PCI TIMI flow grade 2 | Post-PCI TIMI flow grade 3 | ST resolution >50% | ST resolution ≤50% |
| 0 or 1 | 9 (12.68) | 7 (9.86) | 2 (2.82) | 5 (7.04) | 4 (5.63) |
| 3 or 2 | 62 (87.32) | 1 (1.41) | 61 (85.91) | 46 (64.79) | 16 (22.54) |

MBG = myocardial blush grade; PCI = percutaneous coronary intervention; TIMI = Thrombolysis In Myocardial Infarction.

4. Discussion

4.1. 'M': Maximum aspiration

No complications, such as stroke, coronary perforation, or thrombus dislodgement, were reported in this study. Notwithstanding the sample size and study design, the death rate at 9 months in the present study (no death) was at least numerically lower to that observed at 12 months in the aspiration arm of the TAPAS³ study (3.6%). The incidence of partial STR in the present study [51 (72%) patients] too is similar to the EXPIRA⁴ trial (63% patients). TIMI grade 3 flow in 89% cases is comparable to the incidence of TIMI grade 3 flow in 86% cases in the TAPAS³ trial.

4.2. 'A': Adjunctive glycoprotein IIb/IIIa inhibitors

Previous findings of positive associations^{5–9} with glycoprotein IIb/IIIa inhibitors are congruent with our results in that up to 9 months after the PCI, no death, reinfarction, or target vessel revascularization was reported. Furthermore, none of the subjects in the present study encountered any major bleeding episode.

4.3. 'P': Prolonged balloon inflation

While thrombus aspiration acts on the intraluminal thrombus, glycoprotein IIb/IIIa inhibitors act at the microvascular level. Effectively, the first two components ('M' and 'A') address intraluminal and microvascular thrombus. It is postulated that the third component ('P') addresses intralésional thrombus. Rapid balloon inflation and deflation abruptly disrupts and fragments the atheromatous material and results in distal microembolization, as well as platelet activation, contributing to acute occlusion. On the contrary, it is speculated that the prolonged inflation possibly compresses the intralésional plaque against the arterial wall and entraps it under the stent struts, thus leading to reduced intravascular as well as intracapillary thrombus burden.

5. Limitations

First, the sample was small and belonged to a single center, and may not accurately represent diverse cases. Second, the 'MAP strategy' was not compared with a control group, which makes it difficult to state whether the observed favorable outcomes were superior, equivalent, or inferior to PCI alone.

Third, the analysis was retrospective, and could be confounded by several variables. Lastly, complex patients were not included.

6. Key messages

- The most interesting aspect of the 'MAP strategy' was that it resulted in zero cases of TIMI flow grade 0 or 1 ('no-reflow').
- The 'MAP strategy' is technically feasible and safe to implement in day-to-day practice.
- Addition of a simple step of prolonged inflation can improve angiographic and clinical outcomes; however, this concept needs to be tested in large, controlled studies.

Conflicts of interest

The authors have none to declare.

REFERENCES

1. Chesebro J, Knatterud G, Roberts R, et al. Thrombolysis In Myocardial Infarction (TIMI) Trial. Phase I. A comparison between intravenous tissue plasminogen activator and intravenous streptokinase. Clinical findings through hospital discharge. *Circ Am Heart Assoc.* 1987;76:142-154.
2. Van't Hof A, Liem A, Suryapranata H, et al. Angiographic assessment of myocardial reperfusion in patients treated with primary angioplasty for acute myocardial infarction: myocardial blush grade. *Circulation.* 1998;97:2302.
3. Vlaar PJ, Svilaas T, van der Horst IC, et al. Cardiac death and reinfarction after 1 year in the thrombus aspiration during percutaneous coronary intervention in acute myocardial infarction study (TAPAS): a 1-year follow-up study. *Lancet.* 2008;371:1915-1920.
4. Sardella G, Mancione M, Bucciarelli-Ducci C, et al. Thrombus aspiration during primary percutaneous coronary intervention improves myocardial reperfusion and reduces infarct size: the EXPIRA (thrombectomy with export catheter in infarct-related artery during primary percutaneous coronary intervention) prospective, randomized trial. *J Am Coll Cardiol.* 2009;53:309-315.
5. Montalescot G, Antoniucci D, Kastrati A, et al. Abciximab in primary coronary stenting of ST-elevation myocardial infarction: a European meta-analysis on individual patients' data with long-term follow-up. *Eur Heart J.* 2007;28:443-449.
6. De Queiroz Fernandes Araújo JO, Veloso HH, Braga De Paiva JM, et al. Efficacy and safety of abciximab on acute myocardial infarction treated with percutaneous coronary interventions: a meta-analysis of randomized, controlled trials. *Am Heart J.* 2004;148:937-943.
7. Kandzari DE, Hasselblad V, Tchong JE, et al. Improved clinical outcomes with abciximab therapy in acute myocardial infarction: a systematic overview of randomized clinical trials. *Am Heart J.* 2004;147:457-462.
8. Kouz R, Kouz S, Schampaert E, et al. Effectiveness and safety of glycoprotein IIb/IIIa inhibitors in patients with myocardial infarction undergoing primary percutaneous coronary intervention: a meta-analysis of observational studies. *Int J Cardiol.* 2011;153:249-255.
9. Gurm H, Tamhane U, Meier P, et al. A comparison of abciximab and small molecule glycoprotein IIb/IIIa inhibitors in patients undergoing primary percutaneous coronary intervention: a meta-analysis of contemporary randomized controlled trials. *Circ Cardiovasc Interv.* 2009;108.