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Deferred Stenting Strategy in Acute STEMI with High Thrombus Burden: Clinical and Angiographic Outcomes

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Abstract :

Background: In ST-elevation myocardial infarction (STEMI) with high thrombus burden, immediate stenting may increase distal embolization, no-reflow, and acute stent thrombosis. Deferred stenting has been proposed as a selective alternative strategy. We evaluated the feasibility, safety, and short-term outcomes of deferred stenting in patients presenting with STEMI and large angiographic thrombus burden.

Methods: We conducted a prospective, single-centre observational case series including consecutive STEMI patients managed within 48 h of symptom onset and presenting with thrombus grade ≥4 or TIMI flow ≤2. Initial management consisted of gentle mechanical reperfusion without stent implantation, combined with dual antiplatelet therapy, unfractionated heparin, and tirofiban infusion. A planned second angiography was performed between 48 h and 7 days; stenting was undertaken only when significant residual stenosis persisted. Outcomes included thrombus regression, final TIMI flow, in-hospital events, and short-term clinical and echocardiographic evolution.

Results: Thirteen patients (mean age 52 years, 69% male) were included. Deferred angiography was performed in 12 patients (one in-hospital non-cardiac death). Complete thrombus resolution occurred in 10/12 (83%), and partial regression in 2/12 (17%). Deferred stenting was required in 4/12 (33%), while 8/12 (67%) were managed conservatively. Final TIMI 3 flow was achieved in all reassessed patients, with no no-reflow, stent thrombosis, or major bleeding. Mean LVEF improved from 40% at baseline to 47% at 3 months.

Conclusions: In this selected thrombus-rich STEMI population, deferred stenting combined with intensive antithrombotic therapy was feasible and associated with high thrombus regression, excellent angiographic outcomes, and short-term improvement in left ventricular function. These findings support deferred stenting as a potential option in carefully selected high-thrombus STEMI cases and warrant confirmation in larger comparative studies.

Introduction :

Acute myocardial infarction with ST-segment elevation (STEMI) remains a major cardiovascular emergency worldwide, accounting for substantial morbidity and mortality despite advances in reperfusion therapy. Primary percutaneous coronary intervention (PCI) with immediate stent implantation has become the gold standard for restoring coronary blood flow, as emphasized by the latest European Society of Cardiology (ESC)

guidelines. Early stenting of the culprit artery ensures rapid and durable reperfusion, thereby reducing infarct size and improving survival.

However, in patients presenting with a large angiographic thrombus burden, immediate stenting may be associated with significant procedural hazards. These include distal embolization, no-reflow phenomenon, and acute or subacute stent thrombosis, which can negatively affect microvascular reperfusion and long-term ventricular recovery. Conversely, restoring epicardial flow by gentle balloon dilatation, thromboaspiration or guidewire passage, followed by intensive antithrombotic therapy, may allow spontaneous thrombus regression before definitive stent implantation.

This “deferred stenting” approach has been proposed as an alternative in selected patients, with the rationale of reducing acute complications and optimizing angiographic and clinical outcomes. Yet, its role in daily clinical practice remains controversial, and guideline recommendations continue to support immediate stenting as the default strategy, while acknowledging the potential need for individualized decisions in complex scenarios.

Against this background, we aimed to assess the feasibility, safety and short-term outcomes of a deferred stenting strategy in patients with STEMI and high thrombus burden, managed at a tertiary cardiology centre.

Methods :

a. Study design and setting

We conducted a prospective, single-centre observational study at a tertiary cardiology centre over an 18-month period. The study included consecutive patients admitted for STEMI with high thrombus burden and managed using a deferred stenting strategy. Written informed consent was obtained from all patients prior to inclusion.

b. Study population

Consecutive patients admitted with acute ST-elevation myocardial infarction (STEMI) were screened. Eligible patients fulfilled all of the following criteria:

 STEMI diagnosis according to ESC 2023 guidelines, with symptom onset <48 hours

before admission;

 High angiographic thrombus burden defined as visible thrombus with TIMI thrombus grade ≥4, TIMI flow ≤2 despite wire passage, or a floating/persistent occlusive thrombus;

 Suitability for urgent PCI.

c. Exclusion criteria were: STEMI with low thrombus burden, late presenters (>48 hours after symptom onset), non-ST-elevation myocardial infarction (NSTEMI), or myocardial infarction with non-obstructive coronary arteries (MINOCA).

d. Initial management (acute phase, <48 h)

All patients received a loading dose of aspirin 300 mg and clopidogrel 600 mg on admission. In the catheterization laboratory, unfractionated heparin (100 IU/kg IV) were systematically administered. Following the initial procedure, therapeutic-dose anticoagulation with enoxaparin sodium was maintained (1 mg/kg). Tirofiban bolus (25 μg/kg IV over 5 min) followed by maintenance infusion (0.15 μg/kg/min for 18–24 h) were administered in 10 patients.Coronary angiography was performed primarily via radial access. In the presence of high thrombus burden, only gentle mechanical reperfusion was performed (wire crossing, low-pressure balloon dilatation, and/or manual thromboaspiration). No stent was implanted during this first procedure. A residual TIMI 2 or 3 flow was required for completion of the initial intervention.

e. Deferred phase (48 h to 7 days)

A second angiography was scheduled 2–7 days later, depending on clinical and biological evolution. Thrombus regression was reassessed. In cases of significant residual stenosis, a drug-eluting stent was implanted; otherwise, conservative medical management was pursued. Post-procedure angiographic endpoints included final TIMI flow, myocardial blush grade, and absence of procedural complications (dissection, embolization, no-reflow).

f. Endpoints

 Primary endpoint: feasibility, clinical safety, and angiographic efficacy of deferred stenting in STEMI with high thrombus burden.

 Secondary endpoints: (i) thrombus regression between the acute and deferred phases,

(ii) incidence of in-hospital complications (reinfarction, bleeding, death, no-reflow), (iii) left ventricular ejection fraction (LVEF) evolution at baseline and 3 months, (iv) clinical outcomes at 30 days (mortality, rehospitalisation, bleeding).

g. Data collection

Baseline demographics, cardiovascular risk factors, clinical presentation, biological markers (troponin, creatinine, lipid profile, glycaemia), angiographic characteristics (culprit artery, TIMI flow, thrombus grade, myocardial blush), procedural details, and echocardiographic data were prospectively recorded.

h. Statistical analysis

1 Continuous variables were expressed as mean ± standard deviation, and categorical variables as counts and percentages. Comparisons between baseline and follow-up variables were performed using Student's t test or Wilcoxon signed-rank test, as appropriate. A two-sided p value <0.05 was considered statistically significant. Analyses were conducted using SPSS version 25.

Results :

a. Baseline characteristics

Thirteen patients were included, with a mean age of 52 years (range 33–64); 9 (69.2%) were male. Cardiovascular risk factors were common: smoking in 8 patients (61%), type 2 diabetes in 5 (38%), hypertension in 3 (23%), and dyslipidaemia in 3 (23%). No patient had a family history of premature coronary artery disease. The mean delay from symptom onset to first medical contact was 10 h 20 min ± 2 h 15 min. At admission, 12 patients were Killip class I and 1 was Killip class III.

b. Angiographic findings (acute phase)

The culprit vessel was 2 the left anterior descending artery in 8 patients (61%), the right coronary artery in 3 (23%), and the circumflex artery in 2 (15%). All patients had angiographic thrombus grade ≥4. Initial TIMI flow was 0 in 7 patients, 1 in 2, 2 in 2, and 3 in 2. Gentle reperfusion strategies (guidewire crossing, low-pressure ballooning, or thromboaspiration) were performed without immediate stenting. Post-procedure TIMI flow

improved to grade 2 in 9 patients and grade 3 in 4 patients. No periprocedural complications (dissection, perforation, spasm, or no-reflow) were observed.

c. Deferred angiography

A second angiography was performed in 12 patients (mean interval 5 ± 2 days; one patient died before reassessment from non-cardiac causes). Thrombus regression was complete in 10 patients (83%) and partial in 2 (17%). Deferred stenting with zotarolimus-eluting stents was performed in 4 patients (33%). The remaining 8 patients (67%) were managed conservatively: 7 had non-significant residual stenoses (<50%), and 1 underwent drug-eluting balloon angioplasty without stenting. Final TIMI 3 flow was achieved in all re-evaluated patients, with myocardial blush grade 3 in 9 (75%) and grade 2 in 3 (25%).

d. In-hospital outcomes

The mean hospital stay was 5.8 ± 1.6 days. No cases of recurrent infarction, stent thrombosis, or major bleeding (BARC >2) occurred. One patient, admitted with decompensated heart failure, developed nosocomial pneumonia complicated by severe ARDS and died on day 3.

e. Follow-up

At 30 days, all surviving patients were alive, without recurrent ischaemia, bleeding, or rehospitalisation. At 3 months, echocardiographic follow-up was available in 10 patients (2 lost to follow-up). Mean LVEF improved significantly, from 40 ± 5% at baseline to 47 ± 5% ($p < 0.01$). Partial segmental recovery was noted in 8 patients; 2 remained stable without deterioration.

f. Summary of key outcomes

- Complete thrombus regression in 83% at deferred angiography
- Deferred stenting required in 33% of patients
- Final TIMI 3 flow in 100% of re-evaluated patients
- No cases of no-reflow, acute stent thrombosis, or major bleeding
- One non-cardiac death during hospitalisation

 Significant LVEF improvement at 3 months (40% → 47%, p < 0.01)

Discussion:

2 ST-elevation myocardial infarction (STEMI) is an emergency in which timely reperfusion is the cornerstone of therapy. International guidelines, including the 2023 European Society of Cardiology (ESC) recommendations, endorse primary PCI with immediate stenting of the culprit lesion as the standard of care [1]. This approach reliably restores epicardial flow and improves survival. However, the presence of a large angiographic thrombus burden is increasingly recognised as a high-risk setting in which immediate stenting may precipitate serious complications, including distal embolisation, no-reflow, and acute or subacute stent thrombosis [2,3].

In this context, our prospective single-centre series adds to the ongoing debate regarding deferred stenting. We enrolled 13 STEMI patients with angiographically confirmed heavy thrombus burden (TIMI thrombus grade ≥4). A strategy of initial gentle reperfusion followed by intensive antithrombotic therapy, including systematic tirofiban infusion, led to thrombus regression in the majority of cases. At repeat angiography (mean 5 ± 2 days), 83% of patients showed complete resolution of the thrombus, and only one-third required definitive stenting. Importantly, all patients undergoing deferred evaluation achieved final TIMI 3 flow without no-reflow or intrastent thrombosis.

Our findings are consistent with the hypothesis that deferring stenting may reduce periprocedural complications by allowing thrombus resorption before device implantation. The absence of no-reflow in our cohort is noteworthy, given its strong association with larger infarct size, reduced left ventricular recovery, and worse long-term prognosis [4,5]. Moreover, the significant improvement in mean LVEF at 3 months (from 40% to 47%, p < 0.01) suggests that this strategy may contribute to favourable remodelling.

The literature remains divided on the clinical benefit of deferred stenting. The DEFER-STEMI trial demonstrated reduced no-reflow and improved myocardial salvage with a deferred strategy [6]. Similarly, DANAMI-3-DEFER reported lower rates of heart failure hospitalisation during long-term follow-up, despite neutral effects on overall mortality [7]. By

contrast, the MIMI trial, which included a broader population irrespective of thrombus burden and did not systematically use GP IIb/IIIa inhibitors, failed to show clinical benefit [8]. More recently, SUPER-MIMI suggested that deferral for up to 7 days is safe and may enhance thrombus regression when combined with potent antithrombotic therapy [9]. Our results, obtained in a highly selected thrombus-rich STEMI population, align more closely with the positive outcomes of DEFER-STEMI and SUPER-MIMI.

From a mechanistic perspective, deferred stenting addresses two main challenges: (i) preventing acute stent malapposition due to thrombus volume, and (ii) reducing microvascular injury from embolisation [10]. The use of tirofiban in our study likely contributed to thrombus dissolution and the excellent angiographic outcomes observed. These observations underscore the importance of tailoring revascularisation strategies to thrombus burden rather than applying immediate stenting universally.

Clinical implications

Our findings suggest that, in stable 2 patients with STEMI and heavy thrombus burden, a deferred stenting approach can be safe and associated with favourable short-term outcomes. This strategy may be particularly relevant for lesions in proximal segments or bifurcations, where stent deployment in the presence of thrombus carries higher risk.

Study limitations

Several limitations must be acknowledged. First, the small sample size (n=13) limits statistical power and generalisability. Second, the observational single-centre design without a control group treated with immediate stenting precludes direct comparison between strategies. Third, the follow-up duration was limited to 3 months, insufficient to assess long-term outcomes such as late stent thrombosis, restenosis, or heart failure progression. Finally, the systematic use of tirofiban may not reflect practice in centres where GP IIb/IIIa inhibitors are less frequently used.

Future perspectives

Larger randomised controlled trials specifically targeting 2 patients with STEMI and heavy thrombus burden are warranted. Such trials should clarify the optimal timing of deferred

angiography, the role of adjunctive pharmacological therapy, and the long-term prognostic impact of this strategy.

Conclusion:

In this prospective single-centre study, a deferred stenting strategy in STEMI patients with large thrombus burden proved feasible, safe, and associated with excellent angiographic and short-term clinical outcomes. The systematic use of intensive antithrombotic therapy enabled substantial thrombus regression, final TIMI 3 flow in all cases, and significant improvement in left ventricular function at 3 months, without periprocedural no-reflow, acute stent thrombosis, or major bleeding.

Although limited by small sample size and observational design, our findings support the concept that, in carefully selected patients, deferring stent implantation may be preferable to routine immediate stenting. Larger randomised studies are warranted to confirm the optimal timing and refine patient selection criteria.

In acute STEMI with high thrombus burden, the priority is early reperfusion of the culprit artery; stent implantation should be performed with discernment, rather than as a systematic step of primary PCI.

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Conflicts of Interest Statement

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Consent Statement

Written informed consent was obtained from the patient for the publication of this case report, including all clinical data and accompanying images. All authors have read and approved the final manuscript and agree with its submission.

Authors' Contributions

Mohamed Sarsari, Jamila Zarzur, and Mohamed Cherti all contributed substantially to the conception, drafting, and critical revision of the manuscript. Mohamed Sarsari responsible for data collection, case analysis, literature review and manuscript preparation. Jamila Zarzur and Mohamed Cherti supervised the work and provided senior guidance.

All authors approved the final version of the manuscript and agree to be 1 accountable for all aspects of the work.

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Table 1. Baseline characteristics of the study population (n = 13)

Characteristic

Value

Age, years (mean ± SD)

52 ± 8 (range 33–64)

Male sex, n (%)

9 (69.2)

Cardiovascular risk factors, n (%)

– Current smoking

8 (61.5)

– Type 2 diabetes mellitus

5 (38.5)

– Hypertension

3 (23.1)

– Dyslipidaemia

3 (23.1)

– Family history of premature CAD

0 (0)

– No risk factor

2 (15.4)

Mean delay to first medical contact

10 h 20 min ± 2 h 15 min

Killip class at admission, n (%)

– Class I

12 (92.3)

– Class II

0 (0)

– Class III

1 (7.7)

– Class IV (cardiogenic shock)

0 (0)

Table 2. Angiographic and clinical outcomes

Outcome

Value

Culprit vessel, n (%)

– 2 Left anterior descending artery

8 (61.5)

– Right coronary artery

3 (23.1)

– Circumflex artery

2 (15.4)

Initial TIMI flow, n (%)

– 0

7 (53.8)

– 1

2 (15.4)

– 2

2 (15.4)

– 3

2 (15.4)

Post-first procedure TIMI flow, n (%)

– 2

9 (69.2)

– 3

4 (30.8)

Deferred angiography performed

12/13 (92.3)

Thrombus regression at second angiography, n (%)

– Complete

10 (83.3)

– Partial

2 (16.7)

Deferred stenting, n (%)

4 (33.3)

Final TIMI 3 flow after second angiography

12/12 (100)

Myocardial blush grade, n (%)

– Grade 3

9 (75.0)

– Grade 2

3 (25.0)

In-hospital mortality

1 (7.7), non-cardiac

Major bleeding (BARC >2)

0 (0)

Reinfarction / stent thrombosis

0 (0)

LVEF at admission (mean ± SD)

40 ± 5%

LVEF at 3 months (mean ± SD)

47 ± 5% ($p < 0.01$)

Patients lost to 3-month follow-up

2

Sources

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