

# Manual Aspiration Thrombectomy in Acute Myocardial Infarction: A Clinical Experience

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## Abstract

Multiple clinical studies have failed to establish the role of routine use of thrombectomy in ST-elevation myocardial infarction (STEMI) patients. There is a paucity of data on the impact of thrombectomy in unselected STEMI patients outside clinical trials. We sought to evaluate the clinical variables and outcomes associated with the performance of thrombectomy in STEMI patients. We retrospectively examined the clinical outcomes in all STEMI patients who underwent successful percutaneous intervention (PCI) at our center. Patients were divided into two groups, one with patients who underwent conventional PCI and another with patients who had thrombus aspiration in addition to conventional PCI. We compared the baseline clinical characteristics, laboratory investigations, re-infarction rates, and all-cause mortality. Total 477 consecutive STEMI patients were identified. Overall, 29% (139) of the patients underwent conventional PCI and 71% (338) of the patients were treated with aspiration thrombectomy and PCI. In addition to the presence of thrombus, patients with nonanterior infarction, and patients with hemodynamic instability requiring intra-aortic balloon pump support were more likely to undergo thrombectomy. Thrombectomy was associated with higher enzymatic infarction (creatinine kinase: 2,796 [2,575] vs. 1,716 [1,662];  $p < 0.0001$ ; CK-MB: 210.6 [156.0] vs. 142.0 [121.9],  $p < 0.0001$ ). However, thrombectomy was not associated with any difference in 30 day reinfarction rate (3.3 vs. 2.9%,  $p = 0.83$ ), mortality (5.0 vs. 7.2%,  $p = 0.35$ ), or composite of death and 30 day reinfarction (7.7 vs. 9.4%,  $p = 0.55$ ). We observed that STEMI patients with anterior infarction and hemodynamic instability were more likely to undergo thrombectomy during primary PCI.

## Keywords

- ▶ acute myocardial infarction
- ▶ angioplasty
- ▶ atherosclerosis
- ▶ infarction
- ▶ myocardial infarction
- ▶ thrombectomy

The outcome of patients with ST-elevation myocardial infarction (STEMI) has significantly improved in the reperfusion era. One of the biggest challenges faced during percutaneous intervention (PCI) of STEMI patients is distal embolization of

thrombus, limiting myocardial reperfusion and adversely affecting clinical outcomes.<sup>1,2</sup> As a result, there has been a growing interest in the idea of thrombus removal to improve the outcomes. The TAPAS (Thrombus Aspiration during

Percutaneous coronary intervention in Acute myocardial infarction Study) trial was the landmark study, which established the role of thrombus aspiration in reducing no-reflow, improving myocardial blush (MB), ST-segment resolution and mortality at 1 year.<sup>3,4</sup> However, subsequent studies have shown conflicting results.<sup>5-11</sup> We sought to evaluate the clinical variables and outcomes associated with the performance of thrombectomy in STEMI patients.

## Methods

### Data and Clinical Definitions

Patients included in this study were evaluated from a single-center STEMI database/registry. This registry was developed as part of a quality improvement and outcome monitoring device. We defined STEMI to be present if the initial electrocardiogram (EKG) showed at least 1-mm ST-segment elevation (> 2-mm ST-segment elevation in right precordial leads, V1-V3) in two or more contiguous leads in standard EKG at the time of the emergency room arrival or in the EKG done by paramedics; in conjunction with ischemic symptoms. All patients who undergo PCI are entered into this prospective registry. Standardized information is collected which includes demographic profile, clinical characteristics, ischemic time, angiographic characteristics and procedural details, laboratory data, hospitalization course, and subsequent clinical follow-up. Ethnicity is self-identified and is finally determined in conjunction with the country of origin. All of these patients routinely receive 325 mg aspirin, 600 mg of clopidogrel, and 80 mg of atorvastatin in the emergency room. Cardiac enzymes were drawn at the time of presentation in the emergency room and subsequently in 6 to 8 hour intervals. Due to the change in hospital's protocol for checking troponin I to troponin T we only report creatine kinase (CK) and CK-MB fraction. Guideline-directed medical therapy is prescribed for all patients, including 81 to 325 mg aspirin, 75 mg clopidogrel, and statins,  $\beta$  blocker, and angiotensin-converting enzyme inhibitor. Patients are routinely contacted 30 days after the discharge. Clinical outcomes are ascertained via telephonic contact with the patient, family, or physician. In addition, the social security death index is reviewed for mortality detection and confirmation. PredischARGE left ventricular function (LVEF) is determined by a follow-up trans-thoracic echocardiogram (done between 3 and 7 days) in all patients. The LVEF is determined using the Simpson biplane formula, according to the recommendations of the American Society of Echocardiography.

PCI is performed according to the best recommended contemporary clinical practice. All patients received bivalirudin during the procedure. The decision on the adjunctive use of glycoprotein IIb/IIIa inhibitors, intra-aortic balloon pump (IBMP), and mode of revascularization: surgical versus percutaneous, bare metal versus drug eluting is at the discretion of the treating interventional cardiologist. The thrombolysis in myocardial infarction (TIMI) grade flow is defined as follows: TIMI 0 flow (no perfusion): absence of any antegrade flow beyond a coronary occlusion; TIMI 1 flow (penetration without perfusion): faint antegrade coronary flow beyond

the occlusion, with incomplete filling of the distal coronary bed; TIMI 2 flow (partial reperfusion): delayed antegrade flow with complete filling of the distal territory; and TIMI 3 flow (complete perfusion): normal flow which fills the distal coronary bed completely. MB was graded as described by Van't Hof et al<sup>12</sup>: Grade 0 to 1 was minimal to no MB or contrast density (relative to the dye density in the uninvolved areas); grade 2 was moderate MB; and grade 3 was normal MB. Persistent MB is considered grade 0. Thrombectomy was performed using either a Fetch (Possis Medical Inc., Minneapolis, MN) or an Export catheter (Medtronic Inc., Minneapolis, MN) before balloon dilation.

### Study Subjects

Our STEMI registry was retrospectively accessed and data were extracted on patients who underwent coronary angiography for STEMI management between August 2008 and November 2012. Patients were excluded if they did not undergo angiography, underwent surgical revascularization, failed revascularization, or died before completion of revascularization.

### Clinical Outcomes/Endpoints

We compared postrevascularization TIMI grade flow in the culprit epicardial vessels, MB score, peak serum cardiac enzyme level, resolution of the elevated ST segments on EKG, 30 day reinfarction, and all-cause mortality between the groups. We defined complete revascularization as grade 3 TIMI flow with a MB score of 2 or greater. EKGs were assessed for ST-segment resolution within 90 minutes after PCI was performed. We defined early complete resolution if ST segments went down by > 70% as compared with the presentation EKG.

### Statistical Methods

Continuous variables are presented as mean ( $\pm$  standard deviation) or, median and interquartile range (IQR) as appropriate, and categorical variables as a percentage. Standard tests were done to check if the data were normally distributed. Continuous data were compared using unpaired Student *t*-test or Mann-Whitney U test as appropriate. Categorical data were compared using Pearson chi-square test. A multivariate analysis using forward stepwise logistic regression was done to check for independent predictors of thrombectomy and clinical outcomes—peak serum CPK, peak serum CK-MB, all-cause mortality, 30-day reinfarction, and a composite of death and mortality. For the multiple regression analyses, univariate analysis was used to select for those factors showing  $p < 0.1$ . A *p*-value of 0.05 was considered significant in both univariate and multivariate analyses. No adjustment was done for multiple analyses. Survival rates were calculated using the Kaplan–Meier method, and differences were tested with the log-rank test. The independent effects of variables on prognosis were calculated using a Cox proportional hazards regression model. Odds ratios (ORs) are presented with their 95% confidence intervals (CIs). Statistical analysis was done using SAS software 9.3 (SAS Institute Inc., Cary, NC) for Windows.

## Results

### Baseline Characteristics

A total of 477 patients were identified. Overall, 29% (139) of the patients underwent conventional PCI, whereas 71% (338) of the patients underwent thrombectomy with PCI. Baseline demographics, clinical characteristics, and angiographic findings are described in ►Table 1. Patients who underwent thrombectomy, compared with conventional PCI, were younger (61.1 [13.3] vs. 64.1 [12.6] years,  $p = 0.03$ ), more likely to present with cardiogenic shock, unstable sustained ventricular arrhythmia requiring electrical defibrillation, thrombotic occlusion of the infarct related artery, and more often required IABP support. We observed an increased utilization of glycoprotein IIB/IIIa inhibitors (21.6 vs. 12.9%,  $p = 0.03$ ) in patients who underwent thrombectomy. Thrombectomy group patients presented with lower left ventricular systolic function as assessed by ventriculography done during diagnostic angiography. In the thrombectomy group there was a trend toward fewer epicardial vessels with significant stenosis (1.8 [0.9] vs. 1.9 [0.9],  $p = 0.09$ ) and lower LVEF (49.6 [11.9] vs. 51.8 [11.1]%,  $p = 0.07$ ) by echocardiogram done at the time of hospital discharge (►Table 1).

### Predictors of Thrombectomy

On multivariate analysis anterior infarction (OR: 1.7, 95% CI: [1.1–2.8],  $p = 0.03$ ), preprocedural TIMI flow 0/1 or occluded artery (OR: 8.6, 95% CI: [4.5–16.4],  $p < 0.0001$ ), and use of IABP support (OR: 0.4, 95% CI: [0.11–1],  $p = 0.06$ ) were found to be independent predictors of thrombectomy usage in addition to the presence of thrombus (►Table 2).

## Clinical Outcomes and Endpoints

### Enzymatic Infarct Size

Patients who underwent thrombectomy had higher peak serum cardiac enzymes (CPK: 2,796 [2,575] vs. 1,716 [1622],  $p < 0.0001$ ; CK-MB: 210.6 [156.0] vs. 142.2 [121.8],  $p < 0.0001$ ). The study sample was divided into two groups, those above and below the median value of the peak CPK (1,740 IU/ng). A second dichotomous grouping was defined by the median of CK-MB (158.1 IU/ng) levels. Age, initial LVEF, and thrombectomy were independent predictors of enzymatic infarct size as measured by CPK and CK-MB (►Table 3).

### ST-Segment Resolution

The two groups did not differ with respect to early ST-segment resolution (thrombectomy: 72% vs. PCI: 67%,  $p = 0.28$ ) and delayed ST-segment resolution (thrombectomy: 90% vs. PCI: 86%,  $p = 0.21$ ). Modeling the time to ST-segment resolution via Cox proportional hazard regression showed that anterior infarction (hazard ratio [HR]: 0.7 95% CI: [0.6–0.9],  $p = 0.014$ ), thrombectomy (HR: 1.6, 95% CI: [1.3–2.1],  $p = 0.0002$ ) and glycoprotein IIB/IIIa use (HR: 0.6, 95% CI: [0.4–0.8],  $p = 0.0003$ ) were independently associated with early ST-segment resolution. Myocardial infarction: 30 day reinfarction rates were similar between the groups with 2.8% in conventional PCI group and 3.2% in thrombectomy group ( $p = 0.83$ ).

### Mortality

Overall, 10 patients died during follow-up in the conventional PCI group versus 17 patients in the thrombectomy group (►Table 4). Mortality rates were similar (5.0 vs. 7.2%,  $p = 0.35$ ). Age (HR: 1.06, 95% CI: [1.0–1.1],  $p = 0.006$ ) and symptom to balloon time (HR: 0.97, 95% CI: [0.96–0.98],  $p < 0.0001$ ) were the only independent predictors of all-cause mortality. IABP support (HR: 4.2 (0.8–21.9),  $p = 0.08$ ) showed trends toward independent association with mortality. Kaplan-Meier analysis showing the survival based on all-cause mortality is presented in ►Fig. 1.

### Death or Myocardial Infarction

Composite of all-cause mortality or 30 day re-infarction were similar in both groups (7.7% versus 9.4%,  $p = 0.55$ ). Age (HR: 1.04, 95% CI: [1.01–1.07],  $p = 0.004$ ), diabetes (HR: 2.0, 95% CI: [1.0–4.1],  $p = 0.05$ ) and symptom to balloon time (HR: 0.99, 95% CI: [0.98–0.99],  $p = 0.015$ ) predicted the composite of death or re-infarction. Severity of CAD as determined by the number of vessels involved (HR: 1.5 [0.94–2.35],  $p = 0.09$ ) showed a trend toward association with the composite of death or myocardial infarction.

## Discussion

The present study is one of the few studies<sup>13–17</sup> which describe the role of routine thrombectomy on enzymatic infarction size, reinfarction, and mortality in a relatively large cohort of unselected STEMI patients who underwent PCI. In our retrospective cohort, we observed that patients with anterior wall myocardial infarction and hemodynamic instability were more likely to undergo mechanical thrombectomy during primary PCI. The mortality and re-infarction rates were comparable between the group who underwent thrombus aspiration and those who underwent conventional primary PCI. We also observed that patients who received thrombectomy sustained larger enzymatic infarction size and had less early ST segment resolution. Concurrent with existing literature, clinical outcomes in our STEMI cohort was influenced by age, presence of diabetes mellitus and ischemic duration.

In STEMI patients, mechanical reperfusion or primary PCI leads to rapid restoration of epicardial flow, which has been associated with improved clinical outcomes including survival.<sup>18,19</sup> However, the patency of epicardial flow does not necessarily indicate adequate myocardial perfusion. This could be explained by microvascular occlusion due to distal embolization of atherothrombotic material during mechanical reperfusion.<sup>20</sup> As many as 30% patients treated with primary percutaneous transluminal coronary angioplasty were found to have no reflow phenomenon jeopardizing myocardial perfusion. Since then various studies and clinical trials have been undertaken to look at different approaches to decrease distal embolization. Mainly based on the results from the TAPAS trial,<sup>3</sup> ACC/AHA/ESC<sup>18,19</sup> advocate use of routine thrombectomy to protect from distal embolization during PCI for STEMI.<sup>21</sup> The findings from TAPAS were replicated in the EXPIRA (thrombectomy with EXPort

**Table 1** Baseline, angiographic, laboratory, and outcome characteristics as classified by thrombectomy during PCI in patients with ST-elevation myocardial infarction

Variable (mean [SD] or n [%])	Thrombectomy		p-Value <sup>a</sup>
	No (139)	Yes (337)	
Baseline characteristics			
Age	64.0 (12.6)	61.1 (13.3)	0.03
Male n (%)	109 (78.4%)	272 (80.5%)	0.61
BMI	27.2 (5.3)	27.3 (5.6)	0.81
Diabetes	47 (33.1%)	95 (28.1%)	0.22
Hypertension	97 (69.8%)	215 (63.6%)	0.20
Hyperlipidemia	87 (62.6%)	208 (61.5%)	0.83
Current smoker	41 (29.5%)	124 (36.7%)	0.13
Exsmoker	31 (22.3%)	68 (20.1%)	0.59
Previous CAD	32 (23.0%)	76 (22.5%)	0.90
Prior MI	11 (7.9%)	27 (8.0%)	0.98
Total ischemic time (median) (IQR)	238 (338.5)	222.5 (342.5)	0.19
Cardiogenic shock	7 (5.0%)	45 (13.3%)	0.008
Sustained VT/VF	1 (0.7%)	22 (6.5%)	0.007
Angiographic characteristics			
No. of vessels involved	1.9 (0.8)	1.8 (0.8)	0.09
LAD infarction	79 (56.8%)	158 (46.7%)	0.045
Preprocedural TIMI flow 0/1	88 (63%)	323 (96%)	< 0.0001
Thrombus	102 (73.4%)	338 (100%)	< 0.0001
IIB/IIIA use	18 (12.9%)	73 (21.6%)	0.03
Vasodilator	105 (75.5%)	251 (74.3%)	0.77
LVEF at the time of angiogram	47.5 (10.3)	44.1 (11.2)	0.003
LVEDP	23.5 (8.4)	24.3 (9.0)	0.36
IABP support	13 (9.4%)	86 (25.5%)	< 0.0001
Lesion stented	136 (97.8%)	333 (98.5%)	0.60
LVEF at the time of discharge	51.8 (11.1)	49.6 (11.9)	0.07
Postprocedural TIMI flow	2.8 (0.4)	2.8 (0.5)	0.92
Myocardial blush grade	2.4 (0.8)	2.5 (0.8)	0.50
Laboratory investigations			
GFR-AD	83.6 (39.1)	87.8 (37.9)	0.28
GFR-DC	94.6 (75.2)	95.2 (44.6)	0.9371
CPK on admission (median) (IQR)	167 (260)	160 (289.25)	0.40
Peak CPK (median) (IQR)	1,061 (1,922)	2,049 (2,695)	< 0.0001
Peak CKMB (median) (IQR)	108 (192.4)	182.5 (217.75)	< 0.0001
Early ST-segment resolution	93 (66.9%)	243 (71.9%)	0.28
Delayed ST-segment resolution	119 (85.6%)	303 (89.6%)	0.21
Death	10 (7.2%)	17 (5.0%)	0.35
Myocardial infarction	4 (2.9%)	11 (3.3%)	0.83
Composite MI or death	13 (9.4%)	26 (7.7%)	0.55

Abbreviations: BMI, body mass index; CAD, coronary artery disease; CK-MB, creatinine kinase myocardial brain fraction; CPK, creatinine phosphokinase; GFR-AD, glomerular filtration rate at admission; GFR-DC, glomerular filtration rate at discharge; IABP, intra-aortic balloon pump; IIB/IIIA, glycoprotein IIB/IIA inhibitor; IQR, interquartile range; LAD, left anterior descending artery; LVEDP, left ventricular end diastolic pressure; LVEF, left ventricular ejection fraction; MI, myocardial infarction; SD, standard deviation; TIMI, thrombolysis in myocardial infarction; VT/VF, ventricular tachycardia/fibrillation.

<sup>a</sup>p-Value generated by independent t-test for continuous variables and "exact" version of the chi-square test for categorical variables.

**Table 2** Multivariate predictors of thrombectomy in ST-segment elevation myocardial infarction patients

Variable	Odds ratio	95% Confidence interval	p-Value
Age	1.01	0.997–1.032	0.11
Cardiogenic shock	1.4	0.385–5.318	0.59
Sustained VT/VF	0.3	0.03–2.04	0.20
LAD infarction	1.7	1.1–2.8	0.03
Preprocedural TIMI flow 0/1	8.6	4.5–16.4	< 0.0001
IIB/IIIA use	0.7	0.4–1.3	0.28
IABP support	0.4	0.1–1.1	0.06
Peak CPK	1.0	1.0–1.0	0.67
Peak CKMB	0.998	0.995–1.000	0.11

Abbreviations: CK-MB, creatinine kinase myocardial brain fraction; CPK, creatinine phosphokinase; IABP, intra-aortic balloon pump; IIB/IIIA, glycoprotein IIB/IIA inhibitor; LAD, left anterior descending artery; TIMI, thrombolysis in myocardial infarction; VT/VF, ventricular tachycardia/fibrillation.

catheter in Infarct-Related Artery during primary percutaneous coronary intervention) study which showed that the infarct size was reduced in patients who underwent manual thrombectomy.<sup>5</sup> However, various single-center and multi-center studies have demonstrated diverse results.<sup>5,7,22–30</sup> In

addition, the strong evidence supporting the benefit of routine thrombectomy on angiographic outcomes, including TIMI grade flow, no-reflow, MB; and ST resolution did not translate well into supporting the mortality benefit.<sup>6</sup> In a randomized trial Kaltoft et al concluded that routine

**Table 3** Predictors of outcomes/endpoints after ST-segment elevation myocardial infarction on multivariate Cox proportional hazards time-to-event analysis

Clinical outcome variables	Predictors	Hazard ratio (95% confidence interval)	p-Value
Death	Age	1.061 (1.018–1.107)	0.006
	Diabetes	1.808 (0.759–4.303)	0.19
	Ever smoked	0.875 (0.351–2.181)	0.77
	Total ischemic duration	0.970 (0.958–0.983)	< 0.0001
	Cardiogenic shock	0.344 (0.070–1.694)	0.19
	IABP support	4.243 (0.822–21.897)	0.08
	LVEF at the time of angiogram	0.987 (0.934–1.042)	0.63
	Number of vessels involved	1.501 (0.787–2.863)	0.22
	LAD infarction	0.751 (0.229–2.464)	0.64
	Thrombectomy	1.307 (0.497–3.432)	0.59
	IIB/IIIA use	0.565 (0.192–1.662)	0.30
Death or 30-d myocardial reinfarction	Age	1.044 (1.014–1.075)	0.004
	Diabetes	2.022 (0.996–4.105)	0.05
	Ever smoked	0.848 (0.412–1.747)	0.66
	Total ischemic duration	0.994 (0.989–0.999)	0.015
	Cardiogenic shock	0.859 (0.223–3.312)	0.82
	IABP support	1.411 (0.378–5.272)	0.61
	LVEF at the time of angiogram	0.997 (0.955–1.041)	0.89
	Number of vessels involved	1.483 (0.936–2.350)	0.09
	LAD infarction	0.812 (0.338–1.948)	0.64
	Thrombectomy	1.921 (0.902–4.091)	0.09
	IIB/IIIA use	0.662 (0.286–1.535)	0.34

**Table 3** (Continued)

Clinical outcome variables	Predictors	Hazard ratio (95% confidence interval)	p-Value
ST-segment resolution	Age	0.997 (0.988–1.006)	0.48
	Diabetes	0.894 (0.697–1.147)	0.38
	Ever smoked	0.986 (0.777–1.251)	0.91
	Total ischemic duration	1.000 (1.000–1.000)	0.46
	Cardiogenic shock	0.651 (0.388–1.091)	0.10
	IABP support	1.227 (0.813–1.851)	0.33
	LVEF at the time of angiogram	1.002 (0.989–1.016)	0.74
	Number of vessels involved	0.997 (0.859–1.157)	0.97
	LAD infarction	0.718 (0.552–0.936)	0.014
	Thrombectomy	1.635 (1.268–2.110)	0.0002
	IIB/IIIa use	0.581 (0.432–0.782)	0.0003
Peak serum CK-MB	Age	0.989 (0.978–1.000)	0.05
	Diabetes	0.788 (0.582–1.068)	0.12
	Ever smoked	0.890 (0.674–1.176)	0.41
	Total ischemic duration	1.000 (1.000–1.000)	0.07
	Cardiogenic shock	0.743 (0.463–1.191)	0.22
	IABP support	1.426 (0.946–2.149)	0.09
	LVEF at the time of angiogram	0.966 (0.951–0.981)	< 0.0001
	Number of vessels involved	1.016 (0.852–1.211)	0.86
	LAD infarction	0.986 (0.715–1.361)	0.93
	Thrombectomy	2.132 (1.539–2.955)	< 0.0001
	IIB/IIIa use	0.845 (0.616–1.161)	0.30
Peak serum CPK	Age	0.982 (0.971–0.993)	0.001
	Diabetes	0.878 (0.654–1.179)	0.39
	Ever smoked	0.795 (0.603–1.048)	0.10
	Total ischemic duration	1.000 (1.000–1.000)	0.36
	Cardiogenic shock	0.838 (0.526–1.336)	0.46
	IABP support	1.403 (0.928–2.119)	0.11
	LVEF at the time of angiogram	0.969 (0.954–0.985)	< 0.0001
	Number of vessels involved	1.055 (0.886–1.258)	0.55
	LAD infarction	1.202 (0.871–1.658)	0.26
	Thrombectomy	2.168 (1.567–2.998)	< 0.0001
	IIB/IIIa use	0.802 (0.586–1.098)	0.17

Abbreviations: CK-MB, creatinine kinase myocardial brain fraction; CPK, creatinine phosphokinase; IABP, intra-aortic balloon pump; IIB/IIIa, glycoprotein IIB/IIIa inhibitor; LAD, left anterior descending artery; LVEF, left ventricular ejection fraction.

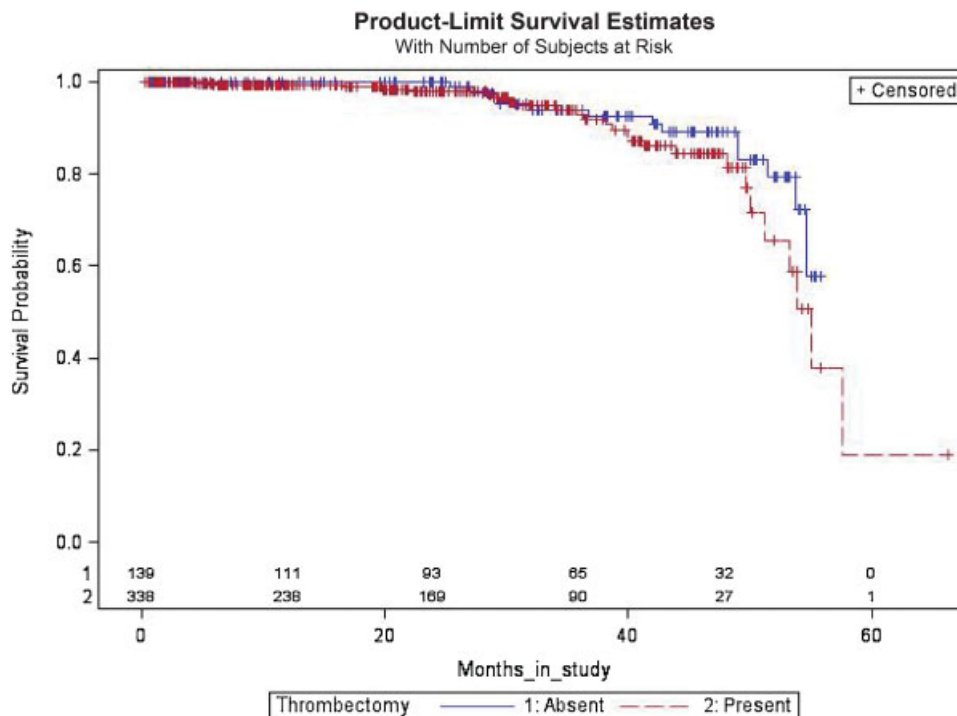
thrombectomy during PCI for STEMI neither benefitted patients, nor jeopardized myocardial salvage resulting in increased infarct size.<sup>7</sup> Meta-analysis done by Bavry et al summarized the differential role of thrombectomy techniques on the outcomes.<sup>8</sup> Another study analyzing nine clinical trials found that manual thrombectomy decreased distal embolization and lowered 30-day mortality.<sup>9</sup> A meta-analysis done by Burzotta et al found that mortality and major adverse cardiac events were reduced only in patients treated with

glycoprotein IIB/IIIa inhibitors.<sup>10</sup> Surprisingly, time to reperfusion and initial TIMI flow did not have any impact on the benefit of thrombectomy. Mongeon concluded after a meta-analysis of 21 clinical trials that routine thrombectomy did not improve 30-day mortality.<sup>11</sup> The MUSTELA (MULTidevice thrombectomy in acute ST-segment Elevation Acute myocardial infarction) trial did not show any reduction in infarct size and transmuralty as assessed by cardiac magnetic resonance imaging at 3 months in patients with high thrombus load.



**Table 4** Death and reinfarction rates according to thrombectomy after PCI in patients with ST-segment elevation myocardial infarction

Variable	Thrombectomy		p-Value
	No (139)	Yes (338)	
Death			
In-hospital mortality/1 mo mortality	2 (1.4%)	12 (3.6%)	0.09
1-y mortality	5 (3.6%)	3 (1%)	0.04
> 1 y mortality	3 (2.2%)	2 (0.6%)	0.15



**Fig. 1** Kaplan–Meier curves for survival rate comparing thrombectomy with conventional PCI group. The number of patients at risk is shown above the x-axis. Log-rank  $p = 0.35$ . PCI, percutaneous intervention.

Most recent study, the TASTE (Thrombus Aspiration during ST-Elevation myocardial infarction) also concluded that manual thrombus aspiration before PCI had no significant effect on the primary endpoint of all-cause mortality at 30 days. The neutral outcome was consistent in all patient subgroups, regardless of baseline clinical or angiographic characteristics.<sup>31</sup>

Routine thrombectomy is not frequently performed in the United States, but there is an increasing temporal trend. An analysis of the CathPCI registry data showed that thrombectomy was performed in only 19% of STEMI patients between July 2009 and December 2010.<sup>32</sup> Use of manual thrombectomy were more likely in patients with preprocedural TIMI 0/1 flow, younger age, saphenous vein graft, glycoprotein IIB/IIIA inhibitor use, and single vessel disease. Similar results were observed in our data, only patients with anterior infarction (OR: 1.7), preprocedural TIMI 0/1 flow (OR: 8.6), and IABP use (most likely for hemodynamic

instability or decompensated heart failure) (OR: 0.4) were more likely to undergo thrombectomy. The difference in results regarding graft and GP IIB/IIIA inhibitor utilization could be attributed to lower rates of graft-related infarction and glycoprotein IIB/IIIA use in our cohort. Despite, the interventional cardiologists bias toward using thrombectomy in TIMI 0/1 flow patients, we did not find a significant interaction between preprocedural TIMI flow and the impact of thrombectomy on mortality or reinfarction rates. Postprocedural TIMI 3 flow was also similar between groups. This could be partly explained by improvements in the management of STEMI patients by the introduction of a newer generation of drug eluting stents, or the use of better pharmacotherapy including the early introduction of statins, angiotensin-converting enzyme inhibitors, optimal dual antiplatelet therapy, and cardiac rehabilitation.

Our study has several limitations. First, it represents a single-center experience using retrospectively collected

data. However, our data set is representative of day-to-day community practices for the management of STEMI. Second, while the study population is modest in size, it remains comparable to several major studies undertaken.<sup>2,3,5,6</sup> Nevertheless, mortality was seen in only 30 patients. The patients with failed revascularization and those who died before completion of revascularization were excluded due to lack of data in our registry. This additional information might have affected the overall mortality and hence the interpretation. Third, we did not evaluate thrombus burden in these patients. However, the TAPAS trial<sup>3</sup> randomized patients to thrombectomy irrespective of angiographic characteristics and findings from the TASTE trial also points toward a lack of association between thrombus characteristics and clinical outcomes. Finally, we were not able to include subsequent PCI, CABG, and nonfatal MI beyond 30 days due to lack of proper documentation. Despite these limitations, the results from this study are clinically relevant and should generate further discussion and motivate future prospective studies.

## Conclusion

Our real-world observation of thrombectomy utilization, found that higher risk STEMI patients with hemodynamic instability are more likely to undergo thrombectomy during primary PCI in an uncontrolled clinical setting.

### Conflict of Interest

None.

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