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Efficacy of Thrombus Aspiration Adjunct to Primary Percutaneous Intervention in ST-elevation Myocardial Infarction Patients with Heavy Thrombus Burden

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Abstract: The efficacy of thrombus aspiration (TA) for various culprit lesions in ST-segment elevation myocardial infarction has not been sufficiently evaluated, this directed recent randomized clinical trials to question its clinical benefits. We aimed to assess the efficacy of TA based primary percutaneous coronary intervention (PCI) in STEMI subgroup with heavy thrombus burden (TB) and compare it with conventional PCI in different STEMI subgroups. A comparative prospective study conducted on 60 patients (age 22–82 years) with acute STEMI who underwent primary PCI at our hospital from January 2016 to January 2017. Study population were divided into two groups: 1) patients with heavy TB or absence of flow after passage of guidewire underwent TA before stent deployment (test group, 30 patients) and 2) patients underwent conventional PCI (comparative group, 30 patients). Median follow-up duration was 5 days. Statistically significant differences; regarding final angiographic flow assessed by thrombolysis in myocardial infarction (TIMI) flow were found between the two groups in (TIMI) 0 before patients on TIMI flow after (TIMI 3 after 75.9 vs. 58.8%, TIMI 2 after 24.1 vs. 17.6%; P=0.05). In Conclusions; It is preferable to use TA before stenting in patients with STEMI with TIMI 0 flow before intervention.

Keywords: Percutaneous Coronary Intervention, Stents, Reperfusion

1. Introduction

Primary percutaneous coronary intervention (PPCI) is an emergent PCI for ST-segment elevation myocardial infarction (STEMI) without previous fibrinolytic treatment [1]. Microvascular obstruction with impaired myocardial perfusion is common in patients after PPCI, and is associated with a large infarct size, decreased recovery of ventricular function, and increased mortality [2].

Improving myocardial reperfusion in patients with STEMI undergoing PPCI have been attempted in several strategies. Direct stenting (DS), which is defined as stent deployment without balloon predilatation, is considered to improve myocardial reperfusion by minimizing distal embolization ultimately causing microvascular occlusion. Although no formal guideline recommendations are available, DS is widely practiced [3]. Improved myocardial reperfusion and a possible reduction in mortality were noted in small trials, but we are lacking large definitive studies [4-7].

Thrombus aspiration (TA) adjunct to PPCI is rapidly performed and relatively inexpensive, and it can be used to reduce the distal embolization [8]. Improvement in myocardial reperfusion was more evident in TA than conventional PPCI and reported in multiple randomized controlled trials [2, 9-10].

TA is not a zero-risk procedure, and may be complicated by systemic embolization. Higher risk of stroke in patients undergoing TA before PPCI was reported in several analyses [11-13]. Therefore, TA can be considered only in selected patients according to current guidelines for the management

of patients with STEMI (Class IIb; Level B) [14]. The clinical benefit of TA in STEMI patients is still debatable. Moreover, it is challenging to identify patients who might make benefit from TA. Our study was designed to assess the effect of adjunct TA to PPCI on clinical outcome and final angiographic flow in STEMI patients.

2. Materials and Methods

2.1. Data Analysis

We obtained analyzed data in this prospective, observational, comparative study from patients with STEMI who were treated with PPCI at the Cardiology Department in Specialized Medical Hospital, Faculty of Medicine, Mansoura University, from January 2016 to January 2017 after obtaining approval from the local ethical committee of the Faculty of Medicine, Mansoura University.

The STEMI diagnosis was settled on 12-lead electrocardiography (ECG) bases, which included persistent elevation of ST-segment or supposed new-onset left bundle branch block (LBBB) combined with either less than 12 h of chest pain or 12–24 h of chest pain with evidence of clinical and/or ECG ongoing ischemia [14].

The number of enrolled patients were limited because of the following exclusion criteria: patients with non-STEMI (NSTEMI) or unstable angina, those with STEMI > 24 h, those with renal impairment (serum creatinine > 2 mg/dL), abnormal bleeding profile [international normalized ratio (INR) > 1.8 or platelet count < 50,000], and those who refused PPCI and selected pharmacological fibrinolysis because of financial causes.

After considering the exclusion criteria, 60 patients were enrolled (age, 22–82 years). These study population were further divided into two groups: 1) patients with heavy thrombus burden (TB) or absence of flow after the passage of guidewire underwent TA before stent deployment [test group, 30 patients (26 males, 4 females)] and 2) patients underwent conventional PPCI by either DS or stenting preceded with balloon predilatation [comparative group, 30 patients (27 males, 3 females)]. Follow-up data were obtained at 3–8 days after hospital admission with 5 days median follow-up duration, which elapsed without complications noted.

Patients who met the inclusion criteria and gave informed consent to participate in the study underwent the following examinations:

2.2. Full History Taking

With an emphasis on age, sex, and occupation; analysis of chest pain, including the timing; exact time elapsed between the start of symptoms until the first hospital admission; door 1-to-door 2 time and door 2-to-balloon time (door 1-to-door 2 time indicated the time elapsed during the transfer of patients from the first hospital contact to Mansoura University Hospital and door 2-to-balloon time indicated the time elapsed during the transfer of patients from the emergency department to restoration of luminal patency in the catheterization laboratory); history of any medication; pre-infarction angina; and coronary artery disease risk factors, such as systemic hypertension, diabetes mellitus, dyslipidemia, and smoking. Hypertension was defined according to the Eighth Joint National Committee (JNC8) as persistent elevation of resting systolic blood pressure more than 140 mmHg, diastolic blood pressure more than 90 mm Hg, or current compliance on medications lowering blood pressure [15]. Diabetes was defined by a prior diagnosis with current antidiabetic medications. The diagnosis of diabetes criteria according to the American Diabetes Association include any of the following: i) hemoglobin A1C (HbA1c) level ≥ 6.5%; ii) fasting plasma glucose more than /or equal 126 mg/dL (7 mmol/L); iii) 2-h plasma glucose more than /or equal 200 mg/dl (11.1 mmol/l) during an oral glucose tolerance test; iv) random plasma glucose more than /or equal 200 mg/dL (11.1 mmol/L) in a patient with traditional symptoms of hyperglycemia (i.e., polyuria, polydipsia, polyphagia, or weight loss) or hyperglycemic crisis [16]. Dyslipidemia was defined by a prior diagnosis with current cholesterol-lowering medications or fasting serum cholesterol level > 200 mg/dl, triglyceride level > 150 mg/dl, and low- and high-density lipoprotein cholesterol levels of >100 mg/dl and <40 mg/dl, respectively [17]. Smokers were defined as current smokers, and ex-smokers were defined as patients who had quit smoking since >6 months.

2.3. Clinical Examination

With an emphasis on i) pulse, ii) blood pressure, iii) neck veins, iv) basal lung crepitation, and v) local cardiac examination.

2.4. Biochemical Assessment

With an emphasis on i) Blood glucose level, ii) serum creatinine level, iii) complete blood count (CBC), iv) INR, and v) troponin I value of each patient were recorded.

2.5. 12-lead ECG

Showing ST-segment elevation according to the European Guidelines (2012). Diagnostic ST-elevation at the J point in at least two contagious leads of ≥2 mm (0.2 mV) in males or ≥1.5 mm (0.15 mV) in females in leads V2-V3 and/or of ≥1 mm (0.1 mV) in other contiguous chest leads or limb leads. Right ventricular ECG leads were applied during special occasions when right ventricular myocardial infarction was suspected. ECG was performed for all patients on admission, immediately after, 90 min after PPCI, and at discharge.

2.6. Echocardiography

For the assessment of i) left ventricle internal dimensions (LVIDs), such as end systolic dimension (normal, 47.86±4.3 mm) and end diastolic dimension (normal, 30.42±3.7 mm); ii) LV global function, such as ejection fraction (EF; normal, 69.14±6.83) and fractional shortening (normal, 36.48±4.81) [18]; and iii) Regional wall motion abnormalities (WMAs), such as hypokinesia, akinesia, and dyskinesia, according to

the 17-segment model of American heart association (AHA), the General Electric Vivid E9 XD clear Dimensions ultrasound system (GE Healthcare, USA) with the M5Sc transducer was used. References for the measured values were those prescribed by the European Society of Cardiology (ESC). Echocardiography was performed in all patients upon admission and before discharge.

2.7. PPCI and Adjunctive Pharmacological Treatment

Done according to the ESC guidelines. Patients were medicated with aspirin (300 mg orally), unfractionated heparin (5000 IU) and clopidogrel or ticagrelor during their first medical contact (FMC) or in the catheterization laboratory [14].

Diagnostic coronary angiography was done through the femoral approach. After which, we assessed the coronary flow using the thrombolysis in myocardial infarction (TIMI) flow grade (TIMI before) as follows [19]: i) TIMI 0, compete occlusion of the infarct-related artery; ii) TIMI 1, some penetration of the contrast material beyond the point of obstruction, but without perfusion of the distal coronary bed; iii) TIMI 2, perfusion of the entire infarct-related vessel, but with delayed flow compared with a normal artery; iv) TIMI 3, full perfusion of the infarct-related vessel with normal flow, after identifying, crossing the culprit lesion with an angioplasty guidewire and percutaneous transluminal coronary angioplasty limited to failed DS or TA catheter passage due to either tight lesions or heavy coronary calcifications using a suitable balloon (usually undersized). A TA catheter was used in patients with heavy TB or absence of flow after the passage of guidewire. Drug-eluting stents (DESs) or bare-metal stents (BMSs) were used according to the recommendations of the European Guideline (2014) [14] with a suitable diameter and length, and inserted according to angiographic findings in each case. After PPCI, coronary flow in the infarct-related vessel was reassessed using the TIMI flow grade (TIMI after).

Patients were then admitted to our coronary care unit for at least 72 h, where ECG was performed immediately after and 90 min after intervention to monitor ST-segment resolution with chest pain resolution after PPCI, and a pre-discharge echocardiography was performed during the patient's hospital stay, with an emphasis on left ventricular EF.

2.8. Statistical Analysis

Data were analyzed using SPSS version 21 (SPSS Inc., Chicago, IL, USA). Normality of data was first tested using one-sample Kolmogorov–Smirnov test.

Qualitative data were presented as number and percentage. The association between categorical variables was tested using chi-square test, and Fisher's exact test and Monte Carlo method were used when the expected cell count was <5. Continuous variables were presented as mean±standard deviation for parametric data and median for non-parametric data. The two groups were compared using Student's t-test for parametric data and Mann–Whitney test for non-parametric data, and paired groups were compared using paired t-test.

For the above-mentioned statistical tests, the threshold of significance was fixed at 5% level (P-value). Results were considered non-significant when the probability of error was >5% ($P > 0.05$), significant when the probability was <5% ($P \leq 0.05$), and highly significant when the probability was <0.1% ($P \leq 0.001$). The smaller the p-value obtained, the more significant were the results.

3. Results

During the study period, 60 consecutive STEMI patients received PPCI. Of these, 30 with heavy TB or absence of flow after the passage of guidewire underwent adjunctive TA of and 30 underwent conventional PPCI. Baseline demographic characteristics and risk factors of the TA and conventional PPCI groups are listed in Table 1. Male predominance (53 males; 88.4%) and smoking (44 smokers; 73.3%) were found to be the most important risk factors among the selected patients, with no significant difference between the two groups in terms of sex and mean age (P=0.688 and 0.166, respectively; Table 1).

Table 1. *Demographic and risk factors data in the study patients and study groups.*

Item	Study patients (n=60)	
	No	%
Sex		
Men	53	88.4%
Women	7	11.6%
HTN	26	43.3%
DM	22	36.7%
Smoking	44	73.3%
Family history	8	13.3%
Dyslipidemia	9	15.0%

Variables	Thrombus aspiration (n=30)		Conventional PPCI (n=30)		Significance Test	p-value
	No	%	No	%		
Gender						
Male	26	86.7	27	90.0	χ^2=0.162	0.688
Female	4	13.3	3	10.0		
Age/years						
Mean±SD	52±13		57±8		t=1.597	0.116
Min-Max	22.00-82.00		40.00-76.00			
HTN	9	30.0	17	56.7	χ^2=4.34	0.037*
DM	8	26.7	14	46.7	χ^2=2.58	0.108
Smoking	21	70.0	23	76.7	χ^2=0.34	0.559
Family History	6	20.0	2	6.7	FET	0.254
Dyslipidemia	6	20.0	3	10.0	FET	0.472

t: student t-test; χ^2: chi square test; FET: Fischer exact test; *: significant p <0.05; No: number; SD: standard deviation; Min: minimum; Max: maximum; HTN: hypertension; DM: diabetes mellitus; PPCI: Primary percutaneous coronary intervention.

Regarding risk factors, there was a significant difference between the two groups regarding hypertension—it was more prevalent in the conventional PPCI group than in the TA group (P=0.037). No significant differences were noted between the two groups in terms of other risk factors, as

shown in Table 1.

No significant difference was found between the two groups regarding the time of onset of chest pain (P=0.081) and the time elapsed from the onset of chest pain until PPCI (P=0.703; Table 2).

Table 2. *Comparison between thrombus aspiration and conventional PPCI as regard clinical, echocardiographic and angiographic data.*

Variables	Thrombus aspiration (n=30)		Conventional PPCI (n=30)		Significance test	p-value
	No	%	No	%		
Arrhythmia before						
No arrhythmias	26	86.7	27	90.0		
CHB (third degree)	1	3.3	1	3.3		
post Arrest (VF)	1	3.3	1	3.3	χ^2=1.019	0.907
PVCs	1	3.3	1	3.3		
HB (mobitz II)	1	3.3	0	0		
Arrhythmia						
yes	4	13.3	3	10.0	FET	1.00
No	26	86.7	27	90.0		
LVID						
dilated	6	20.0	6	20.0	FET	1.00
not dilated	24	80.0	24	80.0		
WMA						
Inferior	8	26.7	5	16.7		
Anterior	18	60.0	23	76.7		
Posterior	0	0	1	3.3	χ^2=7.30	0.121
Infero_lateral	4	13.3	0	0		
Infero_posterior	0	0	1	3.3		
Stent used						
DES	25	83.3	24	80.0		
BMS	5	16.7	5	16.7	χ^2=1.02	0.600
DES & BMS	0	0	1	3.3		
Chest Pain						
Onset time						
Median	11.00 am		7.50 am		Z=1.747	0.081
(Min-Max)	(2.00- 23.00)		(1.00- 23.00)			
onset till PPCI Median	4.00 hours		4.00 hours		Z=0.381	0.703
(Min-Max)	(1.00- 12.00)		(1.00 - 12.00)			
Hemodynamics half an hour before the procedure						
HR	73.60±14.72		79.30±12.41		t=1.621	0.110
SBP	121.67±27.92		129.00±30.55		t=0.970	0.336
DBP	72.33±15.68		75.00±16.34		t=0.645	0.522

t: student t-test; Z: Mann Whitney test; χ^2: chi square test; FET: Fischer exact test; Min: minimum; Max: maximum; PPCI: Primary Percutaneous Coronary Intervention; No: number; CHB: complete heart block; VF: ventricular fibrillation; PVCs: premature ventricular contractions; HB: heart block; LVID: left ventricular internal diameter; WMAs: wall motion abnormalities; DES: drug eluting stent; BMS: bare metal stent; HR: heart rate; SBP: systolic blood pressure; DBP: diastolic blood pressure

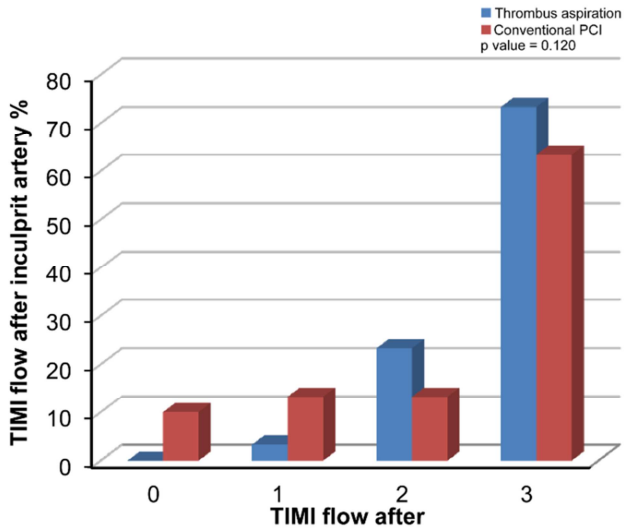

Figure 1. *Comparison of TA and conventional PPCI in terms of TIMI flow after.*

In addition, no significant differences were noted between the two groups in terms of LVID (P=1.00), types of stents used (DESs or BMSs) (P=0.600), site of WMAs (P=0.121), arrhythmia before intervention (P=0.688), and hemodynamics such as heart rate, systolic blood pressure, and diastolic blood pressure before intervention (P=1.621, 0.970, 0.645, respectively; Table 2).

No significant difference was observed between the two techniques regarding TIMI flow after (P=0.120), as shown in Figure 1.

However, the subgroup analysis of patients with TIMI flow 0 before intervention revealed a higher incidence of TIMI flow 3 and 2 after intervention for the TA group (75.9% and 24.1%, respectively) than for the conventional PPCI group (58.8% and 17.6%, respectively; P=0.005). Nevertheless, there were no reported cases of no reflow or TIMI 1 flow with TA in this subgroup; no statistically significant differences were noted between the two techniques in this subgroup in terms of residual stenosis and

final distal TB after intervention (P=0.618 and 0.582, respectively; Table 3).

Table 3. *Comparison between impact of Thrombus aspiration and conventional PPCI regarding TIMI flow before the procedure on TIMI flow after the procedure, residual stenosis, final distal thrombus burden and ST segment resolution.*

	TIMI before							
	0 (n=46)		**1 (n=4)**		**2 (n=4)**		**3 (n=6)**	
	TA (n=29)	**C- PPCI (n=17)**	**TA (n=0)**	**C-PPCI (n=4)**	**TA (n=1)**	**C-PPCI (n=3)**	**TA (n=0)**	**C-PPCI (n=6)**
TIMI after								
0	-	1 (5.9)	-	1 (25)	-	1 (33.3)	-	-
1	-	3 (17.6)	-	1 (25)	1 (100)	-	-	-
2	7 (24.1)	3 (17.6)	-	1 (25)	-	-	-	-
3	22 (75.9)	10 (58.8)	-	1 (25)	-	2 (66.7)	-	6 (100)
P value	0.05*		-		0.135		-	
Test of significance	MC		-		FET		-	
residual stenosis								
Yes	5 (17.2)	2 (11.8)	-	3 (75)	1 (100)	1 (33.3)	-	-
No	24 (82.8)	15 (88.2)	-	1 (25)	-	2 (66.7)	-	6 (100)
P value	0.618		-		0.248		-	
Test of significance	FET		-		FET		-	
final distal thrombus burden								
Yes	8 (27.6)	6 (35.3)	-	3 (75)	1 (100)	1 (33.3)	-	-
No	21 (72.4)	11 (64.7)	-	1 (25)	-	2 (66.7)	-	6 (100)
P value	0.582		-		0.248		-	
Test of significance	χ^2=0.301		-		FET		-	
ST segment resolution								
yes	15 (51.7)	9 (52.9)	-	1 (25)	-	2 (66.7)	-	6 (100)
Partial	9 (31)	4 (23.5)	-	-	-	-	-	-
No	5 (17.2)	4 (23.5)	-	3 (75)	1 (100)	1 (33.3)	-	-
P value	0.805		-		0.248		-	
Test of significance	χ^2=0.433		-		FET		-	
EF after	57.6±9.9	56.2±7.2	-	55.7±9.1	45±0	48.3±16.5	-	61.1±10.3
P value	0.617		-		0.877		-	
Test of significance	t=0.504		-		t=0.175		-	

MC: Monte carlo test, FET: Fischer exact test, χ^2: Chi square test, t: student t-test TS: thrombus suction; C-PPCI: conventional primary percutaneous coronary intervention; TIMI: the thrombolysis in myocardial infarction; EF: ejection fraction.

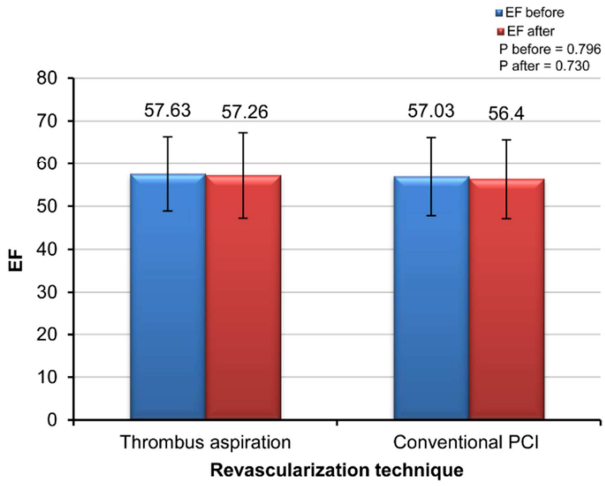

Figure 2. *Comparing of TA to conventional PPCI in terms of EF (before and after).*

No statistically significant differences were observed among patients in the TA and conventional PPCI in TIMI flow 2 before intervention group regarding residual stenosis, final distal TB, and TIMI flow after intervention (P=0.248, 0.248 and 0.135 respectively), and no patients in the TIMI 1 and 3 before subgroups were subjected to TA (Table 3).

During the short-term follow-up at post-intervention (median follow-up duration, 5 days) when the two techniques were compared, no significant improvement in EF or ST-segment resolution after intervention was found (Figures 2 and 3 respectively).

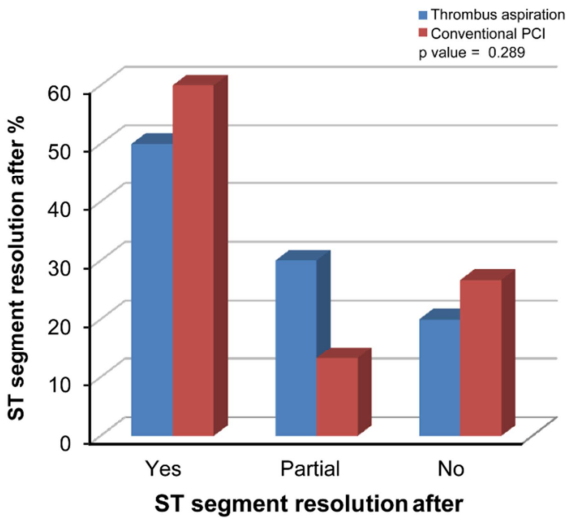

Figure 3. *Comparison of TA and conventional PPCI in terms of ST-segment resolution after intervention.*

No statistically significant differences were noted between

the two techniques in TIMI 0 and 2 before patient subgroups regarding ST-segment resolution (P=0.805 and 0.248, respectively) and EF after intervention (P=0.617 and 0.877, respectively), as shown in Table 3.

4. Discussion

In STEMI patients, the infarct-related coronary artery is mostly totally occluded, and the preferred strategy to restore its patency is PPCI [1]. Indeed, PPCI is preferred over thrombolysis to restore vessel patency because several trials have demonstrated that epicardial blood flow is restored in 90% of patients with PPCI [20].

Despite the great success of PPCI, experts have cautioned against the "illusion of reperfusion," pointing out that the restoration of epicardial vessel patency is not necessarily meaning myocardial reperfusion at the microvascular level [21].

Several strategies to restore coronary vessel patency have been reported. As such, TA is simple, relatively inexpensive, and rapid adjunct to PPCI that may improve blood flow for the restoration of epicardial flow via thrombus removal, thereby improving myocardial reperfusion [22].

This study was conducted to investigate the difference between TA adjunct to PPCI and conventional PPCI with regard to the final angiographic flow, i.e., TIMI flow, after considering the absence of significant difference between the two groups regarding demographic data, risk factors, echocardiographic data, the time of onset of chest pain, time for primary intervention, hemodynamics, and the number and type of stents used to help decide the strategy that should initially be used in different scenarios of STEMI patients.

The present study reported significant improvement in the final TIMI flow in patients with TIMI 0 flow before intervention with TA rather than with the conventional PPCI. However, no significant difference was noticed on the improvement of TIMI flow between the two techniques in patients with TIMI 1 flow or more before intervention.

In a meta-analysis of randomized trial [13], TA during PPCI was shown to be not associated with any benefit on clinical endpoints and was suggested to increase the risk of cerebral stroke; this difference of results may be attributable to the difference in the parameters and duration of follow-up. In our study, differences between the two techniques in TIMI flow, ST resolution, and EF improvement after intervention with a of 5 days mean follow-up duration were reported to be directly correlated with the PPCI technique used. However, Elgendy et al. [13] reported differences in mortality rate, reinfarction, stroke, target vessel revascularization, and heart failure hospitalization with 3.7±2.7 months mean follow-up duration that may be attributed to other comorbidities rather than the technique of PPCI used and patient compliance on medical treatment.

In the trial by Jolly et al. [11] for TA in STEMI with >1000 patients, the primary efficacy outcome was 30 days cardiovascular mortality and the primary safety outcome was 30 days stroke or transient ischemic attack. In patients with heavy TB, there was a reduction in cardiovascular deaths, but an increase in the incidence of cerebral stroke and transient ischemic attack was reported. However, in our study, no cerebral strokes or transient ischemic attacks were recorded among patients during their hospitalization period, with a 5 days mean follow-up duration, and the rate of complications after hospitalization was not observed.

Results of the first large, randomized study (TAPAS) observed that TA was beneficial on the 1 year incidence of myocardial reinfarction and cardiac mortality, which increased in the frequency of use of TA [2]. Froebert et al. later reported no benefit of TA before PPCI on the 30-day mortality rate in the TASTE trial [8], which was also matching with the 30-day results in TAPAS [2]. Finally, the TOTAL study failed to identify any benefit of TA in STEMI patients regarding the combined study endpoint (cardiovascular death, myocardial reinfarction, cardiogenic shock, NYHA IV) evaluated after 180 days [23]. In particular, in the TASTE trial, 4697 of 11,709 patients did not undergo randomization because they did not provide informed consent, and these patients had a 10.6% 30-day mortality rate compared with 2.9% among those who underwent randomization [2], Furthermore, none of these trials reported the in-hospital mortality [8].

Based on these data [24], the 2017 ESC guidelines reported that routine TA is not recommended, but may be considered in cases of large residual TB after opening the vessel with a guidewire or a balloon, which is consistent with our results.

The retrospective, propensity score-adjusted study by Blumenstein et al. [9] that involved STEMI patients aimed to evaluate the all-cause mortality rate at discharge and during long-term follow-up with adjunctive TA. TA treated patients had an increased in-hospital mortality rate than those treated conventional PPCI treated patients. However, they reported similar mortality in the two groups during the long-term follow-up. The rehospitalization rate was lower in adjunctive TA group, and this does not agree with the result of our prospective study reporting no mortality in the TA group during the hospitalization period, and in the present study, patients were not followed up after hospital discharge to report the rates of long-term mortality and rehospitalization. Thus, this difference of results may be attributable to the difference in techniques used for patient selection. In our study, the mean age in the TA group was 52 years, whereas in the study by Blumenstein et al. [9], the TA group mean age was 63 years.

Higuchi et al. [25] reported no short-term prognosis improvement among STEMI Japanese patients treated with TA. Notably, no benefit was observed even in large areas of ischemia patients, including patients with LMT or proximal LAD lesions, which does not agree with the result of our prospective study reporting more benefits such as improved final angiographic flow with TA in selected STEMI subgroups; this difference of results may be attributable to the difference in methods used for patient selection. Furthermore, TIMI 0 or 1 flow before PPCI was reported in 97% of patients who underwent TA and in 70% of those who

underwent conventional PCI, while in Higuchi et al. [25], TIMI 0 or 1 flow before PPCI was observed in 74% of patients who underwent TA and in 45% of those who underwent conventional PCI.

5. Conclusion

TA can be performed in STEMI patients, heavy TB and TIMI 0 flow before intervention because it shows superiority over the conventional method in angiographic reperfusion and TIMI flow after stenting, without much difference in the short-term clinical outcome. Moreover, the routine use of TA is not recommended in all patients with STEMI and TIMI 1 or more flow before intervention because no significant difference in clinical outcome or final angiographic reperfusion was observed; furthermore, reduction in expenses, radiation exposure, time, and contrast were noted in TA.

The limitations of this study were as follows: i) It had a low number of patients because several patients refused mechanical reperfusion for financial reasons; ii) only TIMI flow grade was used as an indicator of successful reperfusion because blood flow in epicardial coronaries is not an accurate indicator of myocardial perfusion; iii) lesion, size of TB, and patency of the vessel using intravascular ultrasound (IVUS) and intravascular optical coherence tomography (OCT) before and after intervention were not assessed for the better evaluation of the procedure because these would entail additional costs on patients; and iv) the study had a short follow-up duration, and the mean follow-up duration was only 5 days; moreover, the rate of complications after hospitalization was not evaluated.

Thus, more trials with larger patient samples using new TA techniques and other parameters are recommended for more accurate assessment of TB and myocardial perfusion using IVUS, OCT, and myocardial blush grade and long-term follow-up duration to assess the rate of complications, such as stroke and long-term mortality.

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