Biolife 5(4):484-492
AN INTERNATIONAL QUARTERLY JOURNAL OF BIOLOGY & LIFE SCIENCES
ISSN (online): 2320-4257
www.biolifejournals.com
BIOLIFE ORIGINAL ARTICLE

Impact of manual thrombus extraction on improving myocardial tissue level perfusion and left ventricular remodeling in ST segment elevation myocardial infarction: a prospective comparative study

Abdel Raouf Fahmy[1], Khaled Taema[2], Karim Mashhour[3], Ayman El Naggar[4], Hassan Khaled[5]

[1-5]*Critical Care Department, Cairo University, EGYPT*

Email: kmash@link.net

ABSTRACT

Background: Despite restoration of epicardial blood flow with primary PCI, microvascular obstruction with diminished myocardial perfusion occurs in large proportion of patients. Thrombus manual-aspiration seems to be practical for resolving these issues.

Objective: Evaluate the effect of the Diver TMC.E., aspiration thrombectomy catheter as an adjunct to primary PCI on myocardial perfusion and left ventricular functional recovery and remodeling.

Methods: We included 40 patients [57.8±9.3 year, 31 (77.5 %) males] with acute STEMI eligible for primary PCI. Patients were assigned to undergo either standard PCI (standard PCI group=control group) or PCI with thrombus aspiration (DiverCE thrombus-aspiration group=study group).

Results: Both groups were comparable with no significant differences regarding demographic, clinical, echocardiographic, and angiographic parameters. The percent of thrombus burden reduction was significantly higher in study group (73.50 ± 19.13 %) compared to control group (50.75 ± 23.75 %) (P = 0.002). TIMI flow grade 3 was achieved in 100 % of the DiverCE group patients compared to 50% in control group, P = 0.001). Myocardial Blush Grading improved to 3 in 11 of study group compared to only 2 of control group patients (P=0.01). Complete ST segment resolution was achieved in 70% of study group compared to 35% of the control group patients (P = 0.047). The six months left ventricular end diastolic dimension and wall motion score index were significantly lower in the study group (4.97 ± 0.55 cm and 1.41 ± 0.20) compared to control group (5.49 ± 0.36 cm and 1.66 ± 0.16) (P = 0.001 and 0.044 respectively). Six months left ventricular ejection fraction was significantly higher in study group (56.95 ± 6.15 % Vs 52.10 ± 7.57 %) (P = 0.032).

Conclusions: We concluded that manual thrombus extraction with Diver C.E. catheter as an adjunct therapy in primary PCI for STEMI is a simple, easy-to-use, non-time consuming, procedure which is effective in preventing distal embolization and microvascular obstruction improving myocardial tissue level perfusion and left ventricular remodeling at six months.

Key words: STEMI, Primary PCI, Manual thrombus aspiration, Diver CE.

INTRODUCTION

Timely restoration of normal antitrade flow and tissue level perfusion is key factors in the reduction of mortality in ST-segment elevation myocardial infarction (STEMI). Despite restoration of epicardial blood flow with primary percutaneous coronary intervention (PCI), microvascular obstruction (MVO) with diminished myocardial perfusion occurs in a large proportion of patients, contributing to increased infarct size and reduced survival (1,2).

Mounting interest has emerged regarding the role of distal embolization as a major determinant of

How to Site This Article:
Abdel Raouf Fahmy, Khaled Taema, Karim Mashhour, Ayman El Naggar, Hassan Khaled (2017). Impact of manual thrombus extraction on improving myocardial tissue level perfusion and left ventricular remodeling in ST segment elevation myocardial infarction: a prospective comparative study. *Biolife*. 5(4), pp 484-492. doi: 10.5281/zenodo.7389934

Received:2 October 2017; Accepted;20 November 2017; Available online : 3 December 2017

impaired myocardial perfusion after primary PCI (3,4). In this regard; the use of a mechanical device for thrombus removal is intuitively attractive for improving reperfusion and survival after primary PCI.

Many clinical trials testing these devices have (5-13), yielded conflicting results, in part due to patient and device selection. These trials evaluated mechanical devices with different designs and operational mechanisms. Some mechanical devices may cause physical damage to the vessel endothelium, which may create new thrombi or distal embolization. Thrombus manual-aspiration catheters were seen to be practical for this purpose, because they are relatively flexible and nontraumatic in use, and have become a standard procedure in most centers during primary PCI for acute myocardial infarction (AMI). Indeed, large single-center randomized trials (14, 15) and meta-analyses (16) showed that manual thrombus aspiration is associated with a significant improvement in myocardial perfusion and a reduction in short- and long-term mortalities in patients treated with primary PCI.

This study was intended to:

Evaluate the effect of the Diver TM C.E. aspiration thrombectomy catheter as an adjunct to primary PCI on myocardial tissue-level perfusion.

Evaluate the impact of manual thrombus aspiration during primary PCI on left ventricular functional recovery and remodeling and on clinical outcome.

PATIENTS AND METHODS

During the period between January 2010 and June 2011, forty patients with acute STEMI and angiographic evidence of thrombus-containing lesion eligible for primary or rescue PCI were selected in our study that was done in critical care department, Cairo university hospitals. After enrollment and before coronary angiography, patients were assigned to undergo either standard PCI (standard PCI group=control group) or PCI with thrombus aspiration (Diver CE thrombus-aspiration group=study group).

We included in our study patients with acute STEMI presented within 12 hours of symptom onset with angiographic evidence suggestive of a coronary thrombus. Excluded from the study were patients with previous myocardial infarction (MI), previous coronary artery bypass grafting surgery, Cardiomyopathy, congenital or rheumatic heart disease, and TIMI (thrombolysis in myocardial infarction) grade 2 or 3 flow at the time of initial angiography.

Following admission, all patients were subjected to:

- Standard 12-leads ECG on admission, 90 minutes after the index procedure and every 6 hours for 24 hours, then daily and whenever indicated.
- The patient was informed of the nature of the study and had to sign consent to participate in the study.
- Pharmacologic treatment before and after PCI for all patients in both groups were standardized according to practice guidelines.

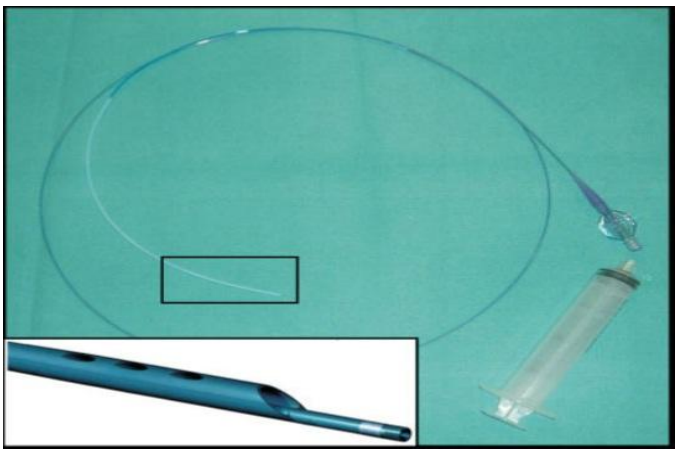
Cardiac catheterization and percutaneous coronary intervention:

All PCIs were performed via right femoral approach. After placement of a 6-French guiding catheter, a 0.014-inch guide wire was advanced through the culprit lesion. In the study group, the manual aspiration was done before any balloon inflations. In de novo lesions, if judged possible by the operator, direct stenting was attempted, while in the remaining cases, predilation with an undersized balloon was used before stent implantation. In control group, predilation attempts were done according to the operator.

The Thrombus-Aspirating Device:

The Diver Clot Extraction (C.E.) (Invatec, Italy) is a rapid-exchange, 0.014-inch guide wire, compatible, thrombus-aspirating catheter. It is a 6-French guiding catheter compatible. It has a central aspiration lumen and a soft, flexible, 0.026-inch, non-traumatic tip with multiple holes (one large, 2 mm, anterior and 3 smaller, 0.9 mm, lateral) communicating with the central lumen (Figure 1). A 30-ml luer-lock syringe connected to the proximal hub of the central lumen is used for flushing with saline solution prior to the procedure and then for manual thrombus aspiration without any further system assembling. A radiopaque marker at the catheter tip allows for accurate catheter positioning (17).

Figure-1. The Diver C.E. thrombus-aspirating device and magnification of the catheter's tip (17)



Angiographic Assessment:

Angiographic parameters assessed:

- TIMI grade flow was assessed from 0-3 referring to levels of coronary blood flow where TIMI 0 flow (no perfusion) refers to the absence of any antegrade flow beyond a coronary occlusion, TIMI 1 flow (penetration without perfusion) is faint antegrade coronary flow beyond the occlusion, with incomplete filling of the distal coronary bed, TIMI 2 flow (partial reperfusion) is

delayed or sluggish antegrade flow with complete filling of the distal territory, and TIMI 3 flow (complete perfusion) is normal flow which fills the distal coronary bed completely (18).

- Myocardial blush grade (MBG) was classified to grade 0 where there was failure of the dye to enter the microvasculature, grade 1 where the dye slowly entered but failed to exit the microvasculature, grade 2 where there was delayed entry and exit of the dye, and grade 3 with normal entry and exit of dye to microvasculature(19).

Thrombus score: Apparent thrombi were subclassified into grade 1, 2, 3, and 4 (on the basis of quantitative measurement of maximum dimension of thrombus relative to normal lumen diameter) (table-1) (20). Thrombus burden reduction was estimated as the percent of thrombus score reduction after the procedure compared to baseline.

Angiographic complications assessment:

- Evaluation of the angiographic complications including distal embolization, no reflow, abrupt vessel closure, dissection, or perforation.

Electrocardiographic Assessment:

- ST segment was analyzed on a standard 12-lead ECG recording just before and 90 minutes after coronary intervention by 2 observers blinded to the clinical data. The Single-Lead ST segment resolution (STR), which is the ST-segment deviation resolution in the single lead showing maximum deviation, was used to assess the extent of microvascular reperfusion in STEMI (21, 22).
- Resolution of ST segment elevation was expressed as a percentage of the initial ST segment elevation. Resolution of ≥70% was defined as complete resolution; indicative of good myocardial reperfusion, STR from 30-70% is considered partial resolution, while STR less than 30% is considered no resolution (23).

Pre-discharge and 30 - days clinical assessment:

- Assessment was done in terms of the incidence of Major Adverse Cardiac Events (MACE) that refers to a composite of Death, reinfarction, and/or target vessel revascularization (TVR) to describe the clinical outcome.

Echocardiographic assessment:

The degree of left ventricular functional recovery and remodeling was assessed by comparing the echocardiographic findings on admission and 6 months follow up.

Regional wall motion was assessed by an echocardiographer who is blind for the clinical, treatment modality and angio-graphic data according to the 16-segment model (24). Wall-motion score index (WMSI) was derived by averaging the scores from each segment. Left ventricular end diastolic dimension (LVED) and left ventricular ejection fraction (LVEF) were measured (25).

The mean value of three measurements of the technically best cardiac cycles was taken from each examination.

Statistical Analysis:

Data were prospectively collected and coded prior to analysis using the professional statistical Package for Social Science (SPSS version 17).

- All data were expressed as mean and standard deviation.
- Frequency tables for all categorical data and descriptive statistics for quantitative data had been performed.
- Student t-test and chi-square test after checking normality for all continuous data.
- Mean values were compared and statistical significance was defined as P≤0.05.

RESULTS

Baseline pre-procedure data:

The two groups were comparable with no significant differences regarding demographic, clinical, echocardiographic, and angiographic parameters (table 2). The Door to dilation time was 79.8±32min in study group compared to 77±29min in control group (P=0.7). The baseline MBG, TIMI flow, and thrombus score were similar in both groups. Pre-intervention MBG was 0 in 17 patients (85%) and 1 in 3 patients (15%) of both groups (P=0.669). TIMI flow was 0 in 16 (80%) and 1 in 4 (20%) of the study group patients compared to 0 in 15 (75%) and 1 in 5 (25%) of the control group patients (P=0.5) and the thrombus score was 4 in 14 (70%) and 3 in 6 (30%) of the patients of both groups (P=0.634). The lesions were de-novo in 17 patients of both groups and in stent thrombosis in 3 (P=1) (table-2).

Procedural Results and Angiographic Outcome:

The duration of the Diver CE procedure averaged 5±10 min and the total interventional procedure time was similar in both groups (51.45±16.67 min in Diver CE group and 44.85±19.4 min in control group (P=0.2) indicating that using Diver CE did not significantly lengthen the procedure.

Comparing between both study and control groups as regard the angiographic results were in favor of the study group. The percent of thrombus burden reduction was significantly higher in study group (73.50±19.13%) compared to control group (50.75±23.75%) (P = 0.002). Comparing final TIMI flow between both groups revealed that it was significantly higher in study group than in control group (TIMI 3 was achieved in 100% of the Diver CE group patients compared to achieving TIMI 3 in 10 (50%), TIMI 2 in 9 (45%), and 1 in 1 (5%) of control group patients, P=0.001) (table-3).

MBG has also improved significantly after thrombus aspiration where it improved to MBG 3 in 11 of study group compared to only 2 of control group patients and MBG 2 in 8 and 16 of study and control groups

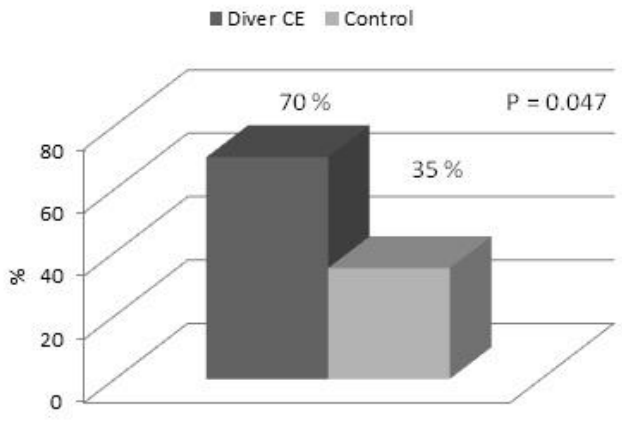
Table-1. Thrombus score (20)

Grade 0	No angiographic characteristic suggestive of thrombus
 Grade 1	Possible thrombus present, with angiographic characteristics such as reduced density, haziness, irregular lesion contour, or presence of smooth meniscus at the occlusion site
 Grade 2	Small thrombus present, with the greatest linear dimension less than half of the vessel diameter
 Grade 3	Moderate thrombus present, with the greatest linear dimension more than half, but less than twice vessel diameter
 Grade 4	Large thrombus present, with the greatest dimension of 2 or more vessel diameters.

respectively (P=0.01) (table 3). We studied some of the procedure complications that are related to MVO as the distal embolization and no-reflow. It was found that the distal embolization was significantly lower in Diver CE group where it occurred in two patients (10%) compared to nine patients in the control group (45%), (P=0.045). The occurrence of no-reflow was also significantly lower in Diver CE group where it occurred in one patient (5%) compared to six patients in the control group (30%), (P=0.04). Dissections that occurred in our patients were non flow limiting and occurred in one patient (5%) of each group after stent implantation (edge dissection) (P=1).

Following the procedure, an ECG was done to compare the ST elevation before and after the procedure in both groups. The incidence of achieving complete ST segment resolution (≥70%) was significantly higher in study group (14 patients (70%) compared to 7 patients in the control group (35%); P=0.047) (Figure-2).

Figure-2. Complete (≥ 70 %) ST Segment resolution in both groups



Hospital course and 30-days MACE:

The two groups were comparable with no statistical significant differences regarding the hospital course and 30-days MACE. The hospital course was complicated in 3 of the study group patients (one patient needed inotropic support, another one needed inotropic support and IABP, and the third had CVA), compared to three, One, and none of control group respectively (P=0.4, 1 & 0.3).

None of our patients of both groups had major bleeding during their hospital stay. Despite the tendency for higher incidence of 30-days MACE in the control group (2 patients compared to 0 in study group), this was not statistically significant (P=0.24).

Six month follow up:

Six months follow up for the echocardiographic parameters including LVED, LVEF, and WMSI was in favor of using Diver CE. The six months LVEDD and WMSI were significantly lower in the study group (4.97±0.55cm and 1.41±0.20) compared to control group (5.49±0.36cm and 1.66±0.16) (P=0.001 and 0.044 for LVED and WMSI respectively). Also the six months LVEF was higher in study group (56.95±6.15%) compared to control group (52.10±7.57%) with significant statistical difference (P=0.032).

DISCUSSION

Timely restoration of normal antegrade flow and tissue level perfusion is key factors in the reduction of mortality in STEMI (1). A significant number of patients with acute STEMI have impaired myocardial tissue perfusion, contributing to increased infarct size and reduced survival, despite restoration of epicardial blood flow with PCI (2). Micro-vascular plugging caused by embolization of thrombotic or atheromatous debris occurring either

Table-2. Baseline Clinical and Angiographic Characteristics of the Study Population

		Diver CE	Control	P value
Age (mean ± SD)		56.4±10.78	59.2±7.51	0.34
Male sex [N(%)]		14 (70%)	17 (85%)	0.25
Hypertension [N(%)]		6 (30%)	10 (50%)	0.19
Diabetes [N(%)]		10 (50%)	9 (45%)	0.72
Hyperlipidemia [N(%)]		9 (45%)	6 (30%)	0.32
Current Smoking [N(%)]		10 (50%)	13 (65%)	0.33
IHD (previous PCI) [N(%)]		3 (15%)	3 (15%)	1
IHD (no previous PCI) [N(%)]		4 (20%)	3 (15%)	0.7
Positive FH of IHD [N(%)]		4 (20%)	5 (25%)	0.7
Obesity (BMI>30) [N(%)]		9 (45%)	6 (30%)	0.32
LVEF during admission (mean ± SD)		55.55±5.34	53.6±6.53	0.3
LVED during admission (mean ± SD)		5.07±0.63	5.29±0.45	0.21
WMSI during admission		1.61±0.22	1.66±0.16	0.4
Door to needle time(min) (mean ± SD)		79.75±32.9	77±29.7	0.7
Anterior infarction [N(%)]		10 (50%)	12 (60%)	0.5
Inferior infarction [N(%)]		10 (50%)	8 (40%)	0.5
Killip class ≥ 3 [N(%)]		2 (10%)	2 (10%)	0.92
LAD is the IRA [N(%)]		10 (50%)	12 (60%)	0.7506
LCX is the IRA [N(%)]		2 (10%)	2 (10%)	1
RCA is the IRA [N(%)]		8 (40%)	6 (30%)	0.7506
Proximal lesion site [N(%)]		16 (80%)	14 (70%)	0.715
Midsegment lesion site [N(%)]		4 (20%)	5 (25%)	1
Distal lesion site [N(%)]		0 (0%)	1 (5%)	0.7
RVD (mm)		2.85±0.27	2.83±0.34	0.83
Lesion length (mm)		16.68±6.73	15±5.78	0.4
Baseline TIMI [N(%)]	0	16 (80%)	15 (75%)	0.5
	1	4 (20%)	5 (25%)	
Baseline thrombus score	3	6 (30%)	6 (30%)	0.634
	4	14 (70%)	14 (70%)	
Baseline MBG [N(%)]	0	17 (85%)	17 (85%)	0.669
	1	3 (15%)	3 (15%)	
Stent length (mm)		22.88±5.43	22.93±5.09	0.97
Stent diameter (mm)		3.11±0.24	3.23±0.36	0.28
Balloon length (mm)		20.31±1.25	19.78±0.94	0.166
Balloon diameter (mm)		2.23±0.34	2.25±0.31	0.888
Procedure time (min)		51.45±16.67	44.85±19.41	0.25

BMI: body mass index; LAD: left anterior descending; LCX: left circumflex; RCA: right coronary artery; IRA: infarct related artery; RVD: reference vessel diameter

spontaneously or after PCI may be one of the major factors responsible for impaired tissue perfusion (4). Therefore different feasible and safe thrombectomy and distal protection devices have been developed for clinical use (26-30). Many trials have been published which investigated the effects of thrombectomy and embolic protection devices on myocardial reperfusion and clinical outcome after AMI (16).

Among various adjunctive devices aimed to protect against such suboptimal flow and embolization, increasing data support that simple manual thrombus aspiration devices which are followed by direct stenting improves myocardial reperfusion and clinical outcome compared with conventional primary PCI which usually needs predilation before stenting(15, 31). We intended in this study to evaluate the effect of the Diver^{TM} C.E. aspiration thrombectomy catheter as an adjunct to primary PCI on myocardial tissue-level perfusion, left ventricular functional recovery and remodeling, and clinical outcome.

Therefore forty patients with acute STEMI eligible for primary or rescue PCI were selected in our study. After enrollment and before coronary angiography, patients were assigned to undergo either standard PCI or PCI

Table-3. TIMI flow, MBG, and thrombus score before and after the procedure in both groups

		Grade	Diver CE Group	Control Group	P Value
TIMI flow	Pre-Intervension [N(%)]	0	15 (75%)	15 (75%)	0.642
		1	5 (25%)	5 (25%)	
		2	0 (0%)	0 (0%)	
		3	0 (0%)	0 (0%)	
	Post-Intervension [N(%)]	0	0 (0%)	0 (0%)	**0.001**
		1	0 (0%)	1(5%)	
		2	0 (0%)	9 (45%)	
		3	20 (100%)	10 (50%)	
MBG	Pre-Intervension [N(%)]	0	17 (85%)	17 (85%)	0.669
		1	3 (15%)	3 (15%)	
		2	0 (0%)	0 (0%)	
		3	0 (0%)	0 (0%)	
	Post-Intervension [N(%)]	0	0 (0%)	0 (0%)	**0.01**
		1	1 (5%)	2 (10%)	
		2	8 (40%)	16 (80%)	
		3	11(55%)	2 (10%)	
Thrombus score	Pre-Intervension [N(%)]	0	0 (0%)	0 (0%)	0.634
		1	0 (0%)	0 (0%)	
		2	0 (0%)	0 (0%)	
		3	6 (30%)	6 (30%)	
		4	14 (70%)	14 (70%)	
	Post-Intervension [N(%)]	0	5 (25%)	0 (0%)	**0.038**
		1	11 (55%)	10 (50%)	
		2	4 (20%)	5 (25%)	
		3	0 (0%)	3 (15%)	
		4	0 (0%)	2 (10%)	

with thrombus aspiration. The two groups were comparable in baseline demographic, clinical, and angiographic characteristics.

The total interventional procedure time was comparable in both groups indicating that the use of Diver CE does not lengthen the procedure time significantly. Aiming to evaluate the effect of the Diver CE aspiration thrombectomy catheter on myocardial tissue-level perfusion we compared the ST segment resolution, MBG, and TIMI flow in both groups before and after the procedure. Complete ST segment resolution (≥70%) was achieved in 14 patients of the study group (70%) compared to 7 patients in the control group (35%); with statistically significant difference. MBG and final TIMI scores were significantly improved in both groups with higher degree of improvement in thrombus aspiration group where MBG grade 3 was achieved in 55% of cases compared to only 2% in control group (P=0.01).

TIMI 3 flow was also achieved in 100% compared to 50% in study versus control groups respectively (P=0.001). These data are concordant with the results reported by Burzotta et al. (2005) (7) and Francesco Liistro et al. (2009) (30). Burzotta et al. found a significant improvement in post-procedural MBG and STR in thrombus aspiration group compared to standard PCI group (MBG≥2 and STR≥70% were achieved in 68.0% and 44.9% in the thrombus-aspiration group compared with 58.0% and 36.7% in the standard PCI group; p = 0.020, and 0.034 respectively)(7). Francesco Liistro et al. (2009) also documented a statistically significant improvement in post-procedural TIMI flow in thrombus aspiration group compared to standard PCI group (TIMI grade≥2 was attained in 93% in the thrombus-aspiration group compared with 71% in the standard PCI group; P=0.006) (30).

Data from the TAPAS trial (15) randomized 1072 STEMI patients before angiography to manual thrombectomy or conventional primary PCI. This study showed significant benefits in myocardial perfusion (evaluated by MBG and STR). The benefits in myocardial perfusion were confirmed in almost all the analyzed subgroups, even though larger benefits were intuitively observed in patients revascularized within the first 3 hours from symptom onset, when the amount of myocardial salvage is relatively high(15). These data and ours reflect that despite both conventional PCI and thrombus aspiration before PCI can significantly improve the epicardial coronary flow, there are more beneficial yields of the thrombus aspiration catheter on myocardial tissue level perfusion, micro-vascular flow and in prevention of micro-vascular obstruction. These

beneficial yields may be attributed to the reduced thrombus burden using the manual aspiration and subsequently decreased incidence of distal embolization, no reflow, MVO, and side branch occlusion.

In this context, we found that the incidence of distal embolization, no reflow and side branch occlusion were lower in study group compared to control group (10% for distal embolization, 10% for side branch occlusion and 5% for no reflow in study group compared to 45%, 30%, and 30% for the three phenomena respectively in the control group). These differences are statistically significant for distal embolization and no reflow (P=0.04 for both) and statistically insignificant for side branch occlusion (P=0.1). This statistical insignificance may be attributed to the small sample size. Many other investigators found similar results with lower incidence of distal embolization and no reflow after using the thrombus extraction devices (16, 32). On the other hand, Burzotta et al. (2005) found that despite distal embolization was lower in study group (8%) compared to control group (17.8%), yet this difference was statistically non-significant (7).

The present study together with other investigators like De Luca et al. (2005) (33) could not conclude an immediate clinical benefit reflected on thirty day MACE in both groups, however some meta-analysis studies demonstrated that utilizing manual aspiration devices in the treatment of AMI was associated with significant reduction in 30-day mortality (15, 16, 39, 40).

The occurrence of MVO comp-licating mechanical reperfusion after AMI was proved to be a major predictor of early LV remodeling (34). LV remodeling after AMI is a precursor of the development of overt heart failure and is an important predictor of mortality (35, 36). Thus, it is conceivable to expect that a thrombus aspiration related reduction in MVO and improvement of myocardial tissue-level perfusion is associated with better LV recovery and limited LV remodeling. Our results were concordant with this hypothesis when using LVED, LVEF, and WMSI as a reflection on the LV functional recovery and remodeling.

We found that the six month echo-cardiography follow up revealed that the mean values of LVED and WMSI were lower in the study group. The mean value of LVEF was significantly higher in study group than in the control group.

Francesco Liistro et al. (2009) also reported a significantly greater improvement in LVEF and in WMSI from baseline to 6-month follow-up in the thrombus-aspiration group compared with the standard PCI group (30).

The myocardial contrast echo-cardiography sub-study of the REMEDIA trial (37) enrolled 50 patients randomly assigned to thrombus aspiration or standard PCI. Thrombus aspiration was associated with a significant reduction in severity and extent of myocardial obstruction, but with only a slight, not significant reduction in LV remodeling at 6 months. De Luca et al(38) showed that, in 76 patients with anterior myocardial infarction, thrombus aspiration was associated with significantly lower end-diastolic and end-systolic LV volumes at 6 months than with conventional PCI.

Bavry et al. (2008) performed a meta-analysis which involved 30 randomized studies with 6415 patients. They found that manual catheter thrombus aspiration during AMI is beneficial in reducing mortality compared with PCI alone (31).

There is increasing evidence that manual aspiration thrombectomy before balloon angioplasty improves myocardial reperfusion and long-term clinical outcomes of AMI patients (30, 31). Many controlled studies however showed that thrombectomy as a routine therapy in primary PCI for STEMI does not increase myocardial salvage, and should be used only in high-risk patients for impaired tissue perfusion(10). On the other hand, some authors considered that adjunctive manual thrombectomy devices, if not anatomically contraindicated, should be routinely used among STEMI patients undergoing primary angioplasty (16).

CONCLUSIONS

Our study demonstrates that manual thrombus extraction with a Diver CE catheter as an adjunct therapy in primary PCI for STEMI is a simple, easy-to-use, non time consuming, cost-effective, and clinically feasible procedure that could prevents distal embolization, no reflow, and MVO improving myocardial tissue level perfusion. It seems to be associated with significantly lower incidence of LV remodeling at six months.

Conflict of Interests

Authors declare that there is no conflict of interests regarding the publication of this paper.

References

1. Ito H, Maruyama A, Iwakura K, et al. Clinical implications of the 'no reflow' phenomenon. A predictor of comp-lications and left ventricular remodeling in reperfused anterior wall myocardial infarction. Circulation 1996;93:223-8.
2. Stone GW, Peterson MA, Lansky AJ, Dangas G, Mehran R, Leon MB. Impact of normalized myocardial perfusion after successful angioplasty in acute myocardial infarction. Journal of the American College of Cardiology 2002; 39:591-7.
3. Topol EJ, Yadav JS. Recognition of the importance of embolization in atherosclerotic vascular disease. Circ. 2000; 101:570-80.
4. Henriques JP, Zijlstra F, Ottervanger JP, et al. Incidence and clinical significance of distal embolization during primary angioplasty for acute myocardial infarction. European heart journal 2002; 23:1112-7.
5. Napodano M, Pasquetto G, Sacca S, et al. Intracoronary thrombectomy improves myocardial reperfusion in patients undergoing direct angioplasty

for acute myocardial infarction. Journal of the American College of Cardiology 2003; 42:1395-402.
6. Antoniucci D, Valenti R, Migliorini A, et al. Comparison of rheolytic thromb-ectomy before direct infarct artery stenting versus direct stenting alone in patients undergoing percutaneous coronary intervention for acute myocardial infarction. The American journal of cardiology 2004;93:1033-5.
7. Burzotta F, Trani C, Romagnoli E, et al. Manual thrombus-aspiration improves myocardial reperfusion: the randomized evaluation of the effect of mechanical reduction of distal embolization by thrombus-aspiration in primary and rescue angioplasty (REMEDIA) trial. Journal of the American College of Cardiology 2005;46:371-6.
8. Lefevre T, Garcia E, Reimers B, et al. X-sizer for thrombectomy in acute myocardial infarction improves ST-segment resolution: results of the X-sizer in AMI for negligible embolization and optimal ST resolution (X AMINE ST) trial. Journal of the American College of Cardiology 2005;46:246-52.
9. Ali A, Cox D, Dib N, et al. Rheolytic thrombectomy with percutaneous coronary intervention for infarct size reduction in acute myocardial infarction: 30-day results from a multicenter randomized study. Journal of the American College of Cardiology 2006; 48:244-52.
10. Kaltoft A, Bottcher M, Nielsen SS, et al. Routine thrombectomy in percutaneous coronary intervention for acute ST-segment-elevation myocardial infarction: a randomized, controlled trial. Circulation 2006; 114:40-7.
11. De Luca G, Suryapranata H, Chiariello M. Aspiration thrombectomy and primary percutaneous coronary inter-vention. Heart 2006; 92:867-9.
12. Silva-Orrego P, Colombo P, Bigi R, et al. Thrombus aspiration before primary angioplasty improves myocardial reper-fusion in acute myocardial infarction: the DEAR-MI (Dethrombosis to Enhance Acute Reperfusion in Myocardial Infarction) study. Journal of the American College of Cardiology 2006; 48:1552-9.
13. Sardella G, Mancone M, Nguyen BL, et al. The effect of thrombectomy on myocardial blush in primary angioplasty: the Randomized Evaluation of Thrombus Aspiration by two throm-bectomy devices in acute Myocardial Infarction (RETAMI) trial. Catheter-ization and cardiovascular interventions: official journal of the Society for Cardiac Angiography & Interventions 2008; 71:84-91.
14. Svilaas T, Vlaar PJ, van der Horst IC, et al. Thrombus aspiration during primary percutaneous coronary intervention. The New England journal of medicine 2008;358:557-67.
15. 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;371:1915-20.
16. De Luca G, Dudek D, Sardella G, Marino P, Chevalier B, Zijlstra F. Adjunctive manual thrombectomy improves myocardial perfusion and mortality in patients undergoing primary percutaneous coronary intervention for ST-elevation myocardial infarction: a meta-analysis of randomized trials. European heart journal 2008;29:3002-10.
17. Burzotta F, Trani C, Romagnoli E, et al. A pilot study with a new, rapid-exchange, thrombus-aspirating device in patients with thrombus-containing lesions: the Diver C.E. study. Catheterization and cardiovascular interventions : official journal of the Society for Cardiac Angiography & Interventions 2006;67:887-93.
18. Gibson CM, Murphy SA, Rizzo MJ, et al. Relationship between TIMI frame count and clinical outcomes after throm-bolytic administration. Thrombolysis In Myocardial Infarction (TIMI) Study Group. Circulation 1999;99:1945-50.
19. Henriques JP, Zijlstra F, van 't Hof AW, et al. Angiographic assessment of reperfusion in acute myocardial infarction by myocardial blush grade. Circulation 2003;107:2115-9.
20. Qureshi AI, Ringer AJ, Suri MF, Guterman LR, Hopkins LN. Acute interventions for ischemic stroke: present status and future directions. Journal of endovascular therapy: an official journal of the International Society of Endovascular Specialists 2000; 7:423-8.
21. Syed MA, Borzak S, Asfour A, et al. Single lead ST-segment recovery: a simple, reliable measure of successful fibrinolysis after acute myocardial infarction. American heart journal 2004; 147:275-80.
22. Schroder K, Wegscheider K, Zeymer U, Neuhaus KL, Schroder R. Extent of ST-segment deviation in the single ECG lead of maximum deviation present 90 or 180 minutes after start of thrombolytic therapy best predicts outcome in acute myocardial infarction. Zeitschrift fur Kardiologie 2001; 90:557-67.
23. Schroder R, Dissmann R, Bruggemann T, et al. Extent of early ST segment elevation resolution: a simple but strong predictor of outcome in patients with acute myocardial infarction. Journal of the American College of Cardiology 1994;24:384-91.
24. Bolognese L, Cerisano G, Buonamici P, et al. Influence of infarct-zone viability on left ventricular remodeling after acute myocardial infarction. Circulation 1997; 96:3353-9.
25. Schiller NB, Shah PM, Crawford M, et al. Recommendations for quantitation of the left ventricle by two-dimensional echocardiography. American Society of Echocardiography Committee on Stan-dards, Subcommittee on Quantitation of Two-Dimensional Echocardiograms. Journal of the American Society of Echocardiography: official publication of the American Society of Echo-cardiography 1989; 2:358-67.
26. Gick M, Jander N, Bestehorn HP, et al. Randomized evaluation of the effects of filter-based distal protection on myocardial perfusion and infarct size after primary percutaneous catheter intervention in myocardial infarction with and without ST-segment elevation. Circulation 2005; 112:1462-9.

27. Bhatt DL, Topol EJ. Does creatinine kinase-MB elevation after percutaneous coronary intervention predict outcomes in 2005? Periprocedural cardiac enzyme elevation predicts adverse outcomes. Circulation 2005; 112 : 906 - 15; discussion 23.
28. De Luca G, Suryapranata H, Stone GW, et al. Abciximab as adjunctive therapy to reperfusion in acute ST-segment elevation myocardial infarction: a meta-analysis of randomized trials. JAMA : the journal of the American Medical Association 2005; 293:1759-65.
29. Burzotta F, Testa L, Giannico F, et al. Adjunctive devices in primary or rescue PCI: a meta-analysis of randomized trials. International journal of cardiology 2008;123:313-21.
30. Liistro F, Grotti S, Angioli P, et al. Impact of thrombus aspiration on myocardial tissue reperfusion and left ventricular functional recovery and remodeling after primary angioplasty. Circulation Cardiovascular interventions 2009;2:376-83.
31. Bavry AA, Kumbhani DJ, Bhatt DL. Role of adjunctive thrombectomy and embolic protection devices in acute myocardial infarction: a comprehensive meta-analysis of randomized trials. European heart journal 2008;29:2989-3001.
32. Burzotta F, Crea F. Thrombus-aspiration: a victory in the war against no reflow. Lancet 2008;371:1889-90.
33. De Luca G, van 't Hof AW, Ottervanger JP, et al. Unsuccessful reperfusion in patients with ST-segment elevation myocardial infarction treated by primary angioplasty. American heart journal 2005;150:557-62.
34. Bolognese L, Carrabba N, Parodi G, et al. Impact of microvascular dysfunction on left ventricular remodeling and long-term clinical outcome after primary coronary angioplasty for acute myocardial infarction. Circulation 2004; 109:1121-6.
35. Pfeffer MA, Braunwald E. Ventricular remodeling after myocardial infarction. Experimental observations and clinical implications. Circulation 1990; 81:1161-72.
36. Bolognese L, Neskovic AN, Parodi G, et al. Left ventricular remodeling after primary coronary angioplasty: patterns of left ventricular dilation and long-term prognostic implications. Circulation 2002; 106:2351-7.
37. Galiuto L, Garramone B, Burzotta F, et al. Thrombus aspiration reduces microvascular obstruction after primary coronary intervention: a myocardial contrast echocardiography substudy of the REMEDIA Trial. Journal of the American College of Cardiology 2006; 48:1355-60.
38. De Luca L, Sardella G, Davidson CJ, et al. Impact of intracoronary aspiration thrombectomy during primary angio-plasty on left ventricular remodelling in patients with anterior ST elevation myocardial infarction. Heart 2006; 92:951-7.
39. Swapna Gurrapu and Estari Mamidala. Medicinal Plants Used By Traditional Medicine Practitioners in the Management of HIV/AIDS-Related Diseases in Tribal Areas of Adilabad District, Telangana Region. *The Ame J Sci & Med Res*.2016:2(1):239-245. doi:10.17812/ajsmr2101.
40. Mahmoud Elsayed Abdelatif, Hazem Alakabawy, Mohamed Fawzy, Abdelraouf Fahmy (2017). Comparison between coronary artery bypass surgery and percutaneous coronary intervention with drugeluting stents for Egyptian diabetic patients with Multivessel disease. Biolife. 5(3), pp 295-302. doi:10.17812/blj.2017.5301.
41. Estari Mamidala and Venkanna Lunavath. Studies on human immunodeficiency virus-1 (HIV-1) protease inhibition by the extracts of fresh water mussel. International Journal of Medical and Pharma Research. 2012. 2(1), 38-42.