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Left Ventricular Longitudinal Strain Following Revascularization in Acute ST Segment Elevation Myocardial Infarction: A Comparison of Primary Angioplasty and Streptokinase Based Pharmacoinvasive Strategy

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ABSTRACT

Background: Two-dimensional speckle-tracking echocardiography (2D STE) has been proven to be more accurate than prognostic metrics such as the left ventricular ejection fraction (LVEF) and wall motion score index (WMSI).

Aim: To contrast the effectiveness of primary percutaneous coronary intervention (PCI) versus Streptokinase based pharmacoinvasive technique in ST elevation myocardial infarction (STEMI) patients.

Patients and methods: In this observational cross section research, 100 patients with acute STEMI were enrolled. They were then divided into two groups: Group A, which included 50 patients who underwent primary PCI as a reperfusion strategy, and Group B, which included 50 patients who underwent pharmacoinvasive technique, which involved streptokinase IV infusion, over the course of a year from November 2020 to November 2021. In order to evaluate the main outcome, which was LV systolic function, all patients had a thorough medical history review, physical examination, 12-lead surface ECG, and echocardiogram (2D global longitudinal strain [GLS] utilizing speckle tracking echocardiography [STE]. **Results:** Pre-intervention GLS showed no statistically substantial variation between the two groups (p=0.768), however post-treatment GLS showed statistically substantial variations between the two groups (p=0.004) and regarding change (%) GLS (p< 0.001).

Conclusion: Primary PCI remains the best option for resolving ischemia. When compared to IV streptokinase treatment, direct coronary angioplasty exhibited a substantial clinical advantage. To treat the myocardial infarction, it was superior to streptokinase based pharmacoinvasive therapy.

Keywords: STEMI; GLS; PCI; Pharmacoinvasive; Speckle tracking echocardiography.

INTRODUCTION

Two-dimensional speckle tracking echo-cardiography (2D STE) has been established to be more accurate than prognostic metrics such as the left ventricular ejection fraction (LVEF) and wall motion score index (WMSI) [(1)].

Patients with STEMI who get timely perfusion had better myocardial survival and LV function. When it comes to mortality and morbidity following a STEMI, LV function is the most critical factor to consider [(2)].

The best way to restore blood flow is to do a primary percutaneous coronary intervention (PCI) on all STEMI patients within 120 minutes of their first medical contact. If initial PCI is not feasible, fibrinolysis should be carried out 30 minutes after arriving at the hospital. When primary PCI is not an option, the pharmaco-invasive approach (Between 3 and 24 hours after taking fibrinolytic medication, fibrinolysis is followed by optional PCI) offers an interesting alternative [(3)].

PCI after effective thrombolysis with Streptokinase and primary angioplasty were the subjects of this cross-sectional multicenter observational research.

The purpose of this research was to compare the effectiveness of primary PCI versus Streptokinase based pharmacoinvasive technique in STEMI patients.

PATIENTS AND METHODS

In this observational cross section study, 100 patients with STEMI were enrolled over the course of a year, from November 2020 to November 2021. The patients were divided into two groups: Group A, which included 50 patients who underwent primary PCI as a reperfusion strategy, and Group B, which included 50 patients who underwent streptokinase-based pharmacoinvasive (PI)technique.

A full medical history was taken of all patients to determine their age, gender, and risk factors for coronary artery disease, such as hypertension, diabetes, dyslipidemia, smoking, and the kind and timing of chest discomfort.

Exclusion criteria: Exclusion criteria included the following: Patients with Killip class IV at the time of presentation, presentation 12 hours after the chest pain first appeared, renal failure, bleeding disorders, platelet count < 50,000, INR >3, financial problems, patient refusal, patients who have had prior PCI or coronary artery bypass grafting (CABG), insufficient echocardiographic windows, device therapy.

Ethical approval:

Mansoura University Ethics Board authorized the research. Before being enrolled in the study, each subject gave their signed, informed consent and received all the information they need during the investigation. The Declaration of Helsinki, the code of ethics of the World Medical Association, was followed while conducting this research on humans.

Clinical examination included: Pressure, pulse, general assessment, and regional cardiac evaluation

Investigations: 12 lead surface electrocardiography, 2D conventional echocardiography, 2D speckle

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tracking echocardiography (STE) to measure LVEF, and other tests were performed as GLS, respectively. Laboratory investigations included serum creatinine, full blood count ,cardiac enzymes and random blood sugar.

Detection of STEMI using the most recent European Society of Cardiology standards from 2018, followed by reperfusion using either primary PCI or a pharmacoinvasive technique based on streptokinase.

Chest pain alleviation, a reduction in ST segment elevation of more than 50% from the baseline electrocardiogram (ECG), the emergence of a reperfusion arrhythmia, and the shooting of cardiac enzymes were used to determine if thrombolysis was successful.

Transthoracic echocardiography: Patients were evaluated using a method that was available for purchase (Vivid 9, General Electric-Vingmed, and Horton, Norway).

At the time of admission (preintervention) and one month later (postintervention), LV systolic function was assessed by 2D global longitudinal strain (GLS) utilizing speckle tracking echocardiography (STE), 2D LVEF utilizing Simpson's biplane approach, and conventional M-mode echocardiography.

All subjects were examined in the left lateral decubitus position.

Coronary Angiography and PCI: Evaluation of the culprit lesions was done and then PCI was performed. During PCI, all patients got a loading dose of 300 mg each of aspirin, clopidogrel, and IV heparin. Baseline and final TIMI flow scores, single or multiple vessels, and angiographic complications such as the presence of contrast induced nephropathy are some of the findings that may be acquired from coronary angiograms, Comparison between the two groups on the basis of outcome, GLS pre-intervention, post-intervention, and change (percent) GLS comparisons between the two groups, Comparison of the LVEFs of the two groups before and after the intervention, as well as the LVEF variation (in percent).

Both groups' clinical outcomes (mortality, massive versus cardiac events (MACE), arrhythmias, heart failure symptoms, bleeding complications and angiographic consequences such as the development of contrast-induced kidney disease) were compared throughout hospitalization in the research. Mortality, re-infarction, and congestive heart failure (late clinical outcomes) are compared between the two groups.

Statistical analysis

The acquired data were statistically analyzed using SPSS statistics for Windows (Statistical Package for the Social Sciences), version 26 (IBM, Armonk, NY, USA). The Shapiro-Wilk test was employed to determine if the data distribution was normal. Every test was run with a 95% confidence level.

A P value of 0.05 or below was regarded as statistically significant. SPSS' chart builder and Microsoft Excel for Windows 2019 were used to create the charts.Categorical data were reported as frequency and percentage, quantitative values were expressed as mean and standard deviation. For comparing parametric and non-parametric continuous data across groups (between people), independent sample T and Mann-Whitney tests were employed, respectively. Utilizing the crosstab function, the Fisher exact and Chi square tests were employed to compare groups of nominal data. Depending on the kind of data, Pearson's or Spearman's correlation coefficients were used to evaluate bivariate correlations.

RESULTS

Table (1): Demographic characteristics and medical history of the study groups:

		Primary PCI (n= 50)	Pharmacoinvasive (n= 50)	95% CI	p-value
Age (years)		**56.04 ± 11.250**	**51.86 ± 12.479**	**- 0.54, 8.90**	**0.082**
Gender (%)	**Male**	**92.0% (46)**	**90.0% (45)**	**-**	**0.727**
	Female	**8.0% (4)**	**10.0% (5)**		
BMI (kg/m2)		**27.38 ± 4.330**	**26.71 ± 4.287**	**-1.05, 2.37**	**0.442**
DM		**40.0% (20)**	**38.0% (19)**	**-**	**0.838**
Hypertension		**36.0% (18)**	**44.0% (22)**	**-**	**0.414**
Dyslipidemia		**58.0% (29)**	**44.0% (22)**	**-**	**0.161**
Smoking		**78.0% (39)**	**84.0% (42)**	**-**	**0.444**
Family history of CAD		**12.0% (6)**	**14.0% (7)**	**-**	**0.766**

Table 1 showed that regarding any age, gender, or BMI, there was no statistically substantial variation between the two groups. Additionally, there was no statistically substantial variation in any of the risk variables between the two groups.

Table (2) Location of infarction of the studied groups:

		Primary PCI (n= 50)	Pharmacoinvasive (n= 50)	P
Location of infarction	**Anterior**	**68.0% (34)**	**70.0% (35)**	**0.971**
	Inferior	**24.0% (12)**	**22.0% (11)**	
	Lateral	**8.0% (4)**	**8.0% (4)**	

This table showed that there was no variation between both groups regarding the location of infarction (p= 0.971) (Table 2).

Table (3) Ejection fraction follow-up between the two studied groups:

Ejection fraction (%)	Primary PCI (n= 50)	Pharmacoinvasive (n= 50)	95% CI	P
Baseline	39.34 ± 8.178	41.10 ± 9.069	-5.19, 1.67	0.311
Post treatment	60.74 ± 10.675	54.60 ± 11.294	1.78, 10.50	**0.006**
Change (%)	57.72 ± 8.121	34.70 ± 5.406	13.43, 32.61	**< 0.001**

This table showed that there was no statistically substantial variation between both groups (p= 0.311) regarding pre intervention EF, while there was statistically substantial variation between both groups (p= 0.006) regarding post treatment EF, and regarding change (%) EF (p < 0.001) (Table 3)

Table (4) GLS follow-up of the studied groups:

GLS	Primary PCI (n= 50)	Pharmacoinvasive (n= 50)	95% CI	P
Baseline	-11.44 ± 2.757	-11.62 ± 3.307	-1.03, 1.39	0.768
Post treatment	-14.66 ± 2.361	-12.88 ± 3.515	-2.97, -0.59	0.004
Change (%)	34.32 ± 6.798	11.82 ± 1.552	11.49, 33.51	**< 0.001**

This table showed that there was no variation between both groups regarding pre intervention GLS (p= 0.768), while there was variation between both groups regarding post treatment GLS (p= 0.004), and regarding change (%) GLS (p < 0.001). (Table 4).

Table (5) GLS follow-up of the studied groups according to site of MI:

GLS		Primary PCI	Pharmacoinvasive	95% CI	P
Anterior	**Baseline**	-11.41 ± 2.776	-11.29 ± 3.054	-1.53, 1.28	0.858
	Post treatment	-14.53 ± 2.246	-12.77 ± 3.309	-3.12, -0.40	**0.012**
	Change (%)	33.59 ± 6.198	14.17 ± 1.192	6.14, 32.69	**0.005**
Inferior	**Baseline**	-11.33 ± 2.807	-12.55 ± 3.882	-1.71, 4.13	0.398
	Post treatment	-14.83 ± 2.443	-13.45 ± 4.228	-4.34, 1.58	0.344
	Change (%)	38.25 ± 4.701	7.64 ± 1.887	2.31, 58.92	**0.035**
Lateral	**Baseline**	-12.00 ± 3.162	-12.00 ± 2.243	-6.47, 6.47	1
	Post treatment	-15.25 ± 3.594	-12.25 ± 2.031	-9.61, 3.61	0.309
	Change (%)	28.75 ± 6.358	2.75 ± 0.500	4.89, 47.11	**0.024**

This table showed that there was statistically substantial variation between both groups as regard anterior MI post treatment GLS (p= 0.012), GLS Change (%) (p = 0.005), inferior MI post treatment GLS Change (%) (p = 0.035), and lateral MI GLS Change (%) (p = 0.024). (Table 5)

Table (6): Early complications of the studied groups:

Early complications	Primary PCI (n= 50)	Pharmacoinvasive (n= 50)	Odds ratio	P
Mortality	0.0% (0)	0.0% (0)	-	1
Re-infarction	2.0% (1)	0.0% (0)	0.495	0.315
CHF	2.0% (1)	0.0% (0)	0.495	0.315
AKI	4.0% (2)	18.0% (9)	5.27	**0.025**
Stroke	0.0% (0)	4.0% (2)	2.04	0.153
Minor bleeding	2.0% (1)	2.0% (1)	-	1
Major bleeding	0.0% (0)	0.0% (0)	-	1

This table showed that there was difference between both groups regarding only AKI (p= 0.025). (Table 6)

Table (7): Late complications of the studied groups after one month follow up:

Late complications	Primary PCI (n= 50)	Pharmacoinvasive (n= 50)	Odds ratio	P
Mortality	4.0% (2)	6.0% (3)	1.53	0.646
Re-infarction	0.0% (0)	6.0% (3)	2.06	0.079
CHF	16.0% (8)	6.0% (3)	0.335	0.110

This table showed that there was no variation between both groups as regard any of the late complications. (Table 7).

DISCUSSION

Patients with STEMI who get timely perfusion had better myocardial survival and LV function [2]. Patients in underdeveloped nations are often unable to get an angiography and PCI within 24 hours due to a variety of causes, including lack of finances (financial constraints, transportation delay). Revascularization may be beneficial for some of these individuals [4].

PCI after effective thrombolysis with Streptokinase and primary angioplasty were the subjects of this cross-sectional multicenter observational research.

Our study results have revealed that the mean age in the primary PCI group was 56.04 ± 11.250 while in the pharmacoinvasive therapy group was 51.86 ± 12.479; the majority of both groups were males . The mean BMI in the primary PCI group was 27.38 ± 4.330 kg/m2 , and in pharmacoinvasive group was 26.71 ± 4.287 kg/m2 ; there was no statistically substantial variation between both groups regarding age, gender, and BMI.

Similar to **Paul and George** [5] study, the mean age of the primary PCI group was 57 ± 13 and in the pharmacoinvasive group was 54 ± 11. The majority of both groups were males, no statistically substantial variation between both groups regarding age and gender was founded.

In the present study, there was no statistically substantial variation between both groups regarding any of risk factors including DM, hypertension, dyslipidemia, smoking and family history of CAD. These results were consistent with the findings of **Sim *et al*.** [6] , however there was only statistically substantial variation between both groups regarding diabetes.

In our study, there was no statistically substantial variation between both groups regarding the location of infarction.

In concordance with **Paul and George** [5] study, 56.7% of primary PCI group and 66.7% of pharmacoinvasive group suffered from anterior wall infarction, without statistically substantial variation between both groups.

Our study results showed that, the majority (70%) of the primary PCI group were Killip class 1, 28% were class 2, and only 2% were class 3; while in pharmacoinvasive group 68% were class 1, 26% were class 2, and only 6% were class 3, without statistically substantial variation between both groups.

In harmony with **Sim *et al.*** [6] study, in which the majority (73.4 %) of the primary PCI group were Killip class 1, 13.7 % were class 2, 7% were class 4, and only 5.9% were class 3. While in pharmacoinvasive group 77 % were class 1, 14.5 % were class 2, 4.9 % were class 3, followed by class 4 (3.5 %).

In our study, the mean time from onset of symptoms until first medical contact, in the primary PCI group was 4.93 ± 2.686 hours , and in pharmacoinvasive group it was 4.28 ± 2.319 hours , without statistically substantial variation between both groups.

This study's median time to revascularization after index chest pain began to be similar to **Paul and George,** [5] and 4.5 hours to start thrombolysis). In the pharmacoinvasive arm, a coronary angiography was conducted within a median of 14 hours following thrombolysis .

Pre-intervention EF and pre-intervention GLS showed no statistically substantial variation between the two groups, while post-treatment EF and GLS, as well as change (percent) EF& (percent) 2D GLS revealed statistically significant differences between the two groups.

The pharmacoinvasive group had considerably lower post-treatment global longitudinal strain (2D speckle tracking) than the main angioplasty group, similar to the work by **Paul and George** .[5]

A primary angioplasty study group examined by **Manjunath *et al*. (4)** had decreased GLS before PCI, but at 6-month follow-up, the GLS had improved statistically significantly (from 11 percent to 13 percent), although it remained below normal. In contrast, it was found that LVEF returned to normal after a period of six months. An improvement in LV function, as measured by GLS six months later in the pharmacoinvasive group, may be particularly beneficial in resource and infrastructure-limited situations where patients are frequently delayed in accessing a PCI-capable hospital.

In our study, regarding early complications, there was statistically substantial variation between both groups regarding only AKI (p= 0.025). While regarding late complications of both groups after one month, there was no statistically substantial variation in any of the late problems between the two groups. Patients with STEMI who cannot reach the guideline required time periods for reperfusion owing to local variables, which are frequent in an economically strapped country like Egypt, would be relieved by this news.

STEMI patients can benefit from any of these two forms of reperfusion therapy. Reperfusion treatment with fibrinolytics is less invasive and doesn't require surgery. PCI-incapable facilities are more likely to use this type of reperfusion treatment. PPCI, on the other hand, is an intrusive treatment that necessitates competence and can only be performed by a trained interventionist, unlike fibrinolytic therapy. Fibrinolysis is most effective when administered during the first four hours after the start of symptoms, particularly within the first 70 minutes of the beginning of symptoms. Patients who aren't ready to go to the hospital, have a poor or unknown medical history, and aren't allowed to employ fibrinolysis may not be able to benefit from this therapy. The recommendations thus urge that patients choose for primary angioplasty even if the two treatment plans are almost identical [7].

Fibrinolysis followed by PCI within 6 to 24 hours of initial PCI was compared in a major clinical Strategic

Reperfusion Early after Myocardial Infarction (STREAM) experiment [8]. No difference was identified in the 30-day composite endpoint of mortality or congestive heart failure or re-infarction between the two therapies. There was an increase in cerebral hemorrhage rates with fibrinolysis-based treatment, however this trend was reversed once the protocol was amended by 50% for patients under the age of 75. STEMI patients who present to non-PCI-capable facilities within 2 to 3 hours after start of symptoms, and who do not have rapid access to PCI, should be treated with a pharmacoinvasive treatment [7].

During the 30-day follow-up period in the **Pu *et al.*** [9] trial, Between the PhI and PPCI groups, the rate of clinical outcomes such as death, nonfatal reinfarction, heart failure, and stroke was equally distributed.

In pharmacoinvasive approach, the time window between fibrinolysis and PCI is critical, however this should not be overlooked.

Routine coronary angiograms and PCI are not yet optimally timed, however, it is appropriate to do a coronary angiogram within 3 to 24 hours following effective fibrinolysis in most patients [7].

CONCLUSION

Primary PCI remains the best option for resolving ischemia. When compared to IV streptokinase treatment, direct coronary angioplasty exhibited a substantial clinical advantage. To treat the myocardial infarction, it was superior to streptokinase based pharmacoinvasive therapy.

DECLARATIONS

- **Consent for publication:** I certify that all writers have given their consent to submit the work.
- **Availability of data and material:** Available
- **Competing interests:** None
- **Funding:** No fund
- **Conflicts of interest:** no conflicts of interest.

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