The preferential benefit of primary percutaneous coronary intervention in patients with ST-segment elevated myocardial infarction: a real-world single-center study

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Background
Ischemic heart disease represents nearly 1.8 million annual deaths or 20% of all Europe deaths. Reperfusion of the ischemic myocardium decreases infarct's size and improves left ventricular function and clinical outcome in patients with acute myocardial infarction.

Objective
The study evaluated the outcome of revascularization strategies [primary percutaneous coronary intervention (PPCI) and fibrinolytic] for patients who presented with ST-segment elevation myocardial infarction (STEMI).

Patients and methods
This is an observational retrospective study that was conducted during March 1, 2018 and August 31, 2018. The study included 232 patients divided into group A (186 patients of them underwent PPCI) and group B (66 patients who received streptokinase).

Results
In group A, 76.9% of them were males, 33.9% were diabetic, 30.1% were hypertensive, 55.4% were smokers, and 17.7% were addicts, whereas in group B, 77.3% were males, 59.1% were smokers, and 16% were addict, and it was found that diabetes mellitus and hypertension presented in 54.5% and 50 of patients, respectively. Anterior myocardial infarction and KILLIP I presentation were nearly the same in both groups. In-hospital mortality was statistically higher in group B than group A (18.18 vs 8.6%; $P = 0.03$). Moreover, the mean of ejection fraction by Simpsons during admission at the PPCI patient was found higher in group A than that in the group B (51.20 ± 9.19 vs 46.7 ± 7.61; $P = 0.001$).

Conclusion
The implementation of PPCI service is beneficial in patients with STEMI in the form of lower in-hospital mortality and better ejection fraction, so primary PCI is preferred as a strategy in patients with STEMI.

Keywords:
fibrinolysis, primary percutaneous coronary intervention, ST-segment elevation myocardial infarction

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Introduction

The reperfusion therapy is extremely important for treatment of acute myocardial infarction (MI) as reperfusion of the ischemic myocardium decreases infarct's size and improves clinical outcome and function of the left ventricle in patients with acute MI [1].

The success of fibrinolytic therapy, especially primary percutaneous coronary intervention (PPCI), is represented by decreased mortality rate in patients with acute MI [1].

Patients and methods

This is an observational retrospective study that was conducted during March 1, 2018 and August 31, 2018.

We included all patients who presented with acute MI and were admitted in the coronary Care Unit of Assiut University Heart Hospital in this period.

IRB of Assiut Faculty of Medicine approved the study (17100289) (ClinicalTrials.gov ID: NCT03266328).

We divided the patients into two groups: group A included 186 patients treated by PPCI and group B included 66 patients treated by thrombolytic (streptokinase).

All patients with PPCI (group A) were subjected to the following:

(1) Personal history, including the following:
   (a) Age.
   (b) Sex.
   (c) Diabetes mellitus (DM), which is a fasting blood sugar greater than or equal to 126 mg/dl or on treatment with either oral hypoglycemic drugs or insulin injections.
   (d) Hypertension (HTN).
   (e) Obesity (BMI > 30 kg/m^2).
   (f) Family history of ischemic heart disease (IHD).
   (g) Smoking: a current smoker was described as the one who smoked at the time of PCI or had quit smoking within 6 months before MI.
   (h) Addiction and type of addiction.
   (i) Chronic kidney disease.
   (j) Multivessel disease and preinfarction angina.
   (k) Ischemic time is defined as the time from start of chest pain to time of balloon inflation. The type of delay responsible for critical time loss was determined as either patient or system delay.
(2) ECG diagnosis of ST-segment elevation myocardial infarction (STEMI) is based on symptoms concordant with myocardial ischemia and signs of ST-segment elevation (measured at the J-point). These symptoms and signs are considered suggestive of acute coronary artery occlusion in the following cases: at least two contiguous leads with ST-segment elevation greater than or equal to2.5 mm in men less than 40 years, greater than or equal to 2 mm in men greater than or equal to 40 years, or greater than or equal to 1.5 mm in women in leads V2–V3 and/or greater than or equal to 1 mm in the other leads [in the absence of left ventricular (LV) hypertrophy or left bundle branch block LBBB)] according to 2017 ESC guidelines of MI [2].
(3) Thorough physical examination:
   (a) General examination.
   (b) Cardiac examination to detect signs of heart failure.
   (c) Chest examination to define Killip score.
(4) Echocardiography:
   Transthoracic echocardiography examination was done for all patients within 24 h of admission to assess ejection fraction (EF) measured by the modified Simpson's method and to detect Segmental wall-motion abnormality:
(5) Coronary angiography and primary PCI: it was done by an interventional cardiologist to evaluate coronary anatomy.
   (a) Infarct-related artery (IRA) (culprit artery) whether it is the left main (LM), left anterior descending (LAD), diagonal, left circumflex (LCx), obtuse marginal, right coronary artery (RCA), posterior descending artery (PDA), or postero-lateral branch.
   (b) Initial TIMI flow according to TIMI flow grading system.
   (c) Number of vessels diseased (multivessel disease was described as >50% decrease in diameter of two or more major epicardial coronary arteries).
   (d) Coronary angiography shows:
   Thrombus was identified according to Practical Cardiovascular Medicine as a round intraluminal filling defect or contrast stain, that is, persistence of contrast over a focal area even after it clears from the rest of the vessel. An abrupt thrombotic vessel cutoff may be present [3].
   (e) Method of reperfusion (either by direct stenting, simple balloon angioplasty, or stenting with pre-dilatation): implantation of stents was highly preferred unless the IRA was severely calcified or culprit luminal diameter was less than 2 mm.
   (f) Stent type (if BMS or DES) and number and contrast volume.
(6) After the procedure:
   (a) TIMI flow of the culprit vessel after PCI was reported.
   (b) Angiographic success was reported after PCI and was defined as residual stenosis less than or equal to 30% and TIMI flow grade 3. The angiographic success of side branch in bifurcation lesion is described as TIMI flow grade 3 and residual stenosis less than or equal to 50%.
   (c) Procedural success after PCI was defined as angiographic success without major complication as MI, death, or emergency coronary artery bypass surgery.
(7) In-hospital outcome was defined as the composite of myocardial reinfarction and mortality.

All streptokinase patients (group B) were subjected to the following:

(1) Personal history taking and physical examination and define Killip score.
(2) ECG: the diagnosis of STEMI is the same as mentioned before.
(3) Echocardiography as mentioned before.
(4) In-hospital follow-up including mortality and reinfarction.

Ethical considerations

Risk-benefit assessment:

No risk affection was seen in the patients in this study.

Confidentiality

All data taken were dealt with in a confidential manner.

Research statement

All patients a signed informed consent about the study and its steps.

Statistical analysis

All collected data were analyzed using SPSS (Statistical Package for the Social Sciences, version 20, IBM, Armonk, New York, USA). Continuous data were expressed in form of mean ± SD or median (range), whereas nominal data were expressed in the form of frequency (percentage).

The nominal data of different groups were compared using χ^2-test, whereas Student's *t*-test was used to compare means of two different groups. The level of confidence was kept at 95%; therefore, a *P* value less than 0.05 indicated a significant association.

Results

Baseline characteristics of the groups

Group A included 186 patients with mean age of 57.03 ± 12.61 years. Overall, 76.9% of them were males, 33.9% were diabetic, 30.1% were hypertensive, 55.4% were smokers, and 17.7% were addicts. Moreover, 29 (15.6%) patients were known to have IHD, eight patients underwent previous PCI, and five patients underwent previous PCI in the same culprit artery, and their mean ischemic time was 6.6 ± 6.1 h (Table 1).

Group B included 66 patients, where 77.3% were males, 59.1% were smokers and 16% were addict. It was found that DM, HTN, and IHD presented in 54.5, 50, and 18.2% of patients, respectively, and their mean ischemic time (defined as the time start from onset of chest pain to balloon) was 4.66 ± 2.36 h.

Both groups had insignificant differences regarding baseline characteristics with exception of group B, which had a significantly higher frequency of DM (33.9 vs 54.5%; *P* = 0.03) and HTN (30.1 vs 50%; *P* = 0.04) in comparison with group A. Total ischemic time was significantly higher in group A (6.6 ± 6.16 vs. 4.66 ± 2.36 h; *P* = 0.04).

Clinical, ECG findings, and echocardiography of the two groups

Regarding the baseline ECG findings in group A, anterior MI was the most frequent type of MI, with a prevalence of 58%. Most patients [130 (71%)] presented with Killip I class, and by echocardiography, it was found that the mean EF by Simpsons during hospital admission was 51.2 + 9.19 (Table 1).

In group B, most patients were in Killip class I (68.2%), and their mean ejection fraction calculated by Simpsons during hospitalization was 46.7 ± 7.61.

In-hospital outcome of the two groups

It was found that the in-hospital mortality was statistically higher in group B (18.18%) than in that of group A (8.6%) (*P* = 0.03), and also the mean EF by Simpsons during admission in group A (51.20 ± 9.19) was higher than in the group B (46.7 ± 7.61) (*P* = 0.001) (Table 2).

Discussion

Regarding demographic data, male sex was found to be the most consistent risk factor for coronary

Table 1 Baseline characteristics of groups A and B

Descriptive data	Group A (*n*=186) [*n* (%)]	Group B (*n*=66) [*n* (%)]	*P*
Age level (years)			
<40	27 (14.5)	12 (18.2)	0.90
>40	159 (85.5)	54 (81.8)	
Sex			
Male	143 (76.9)	51 (77.3)	0.07
Female	43 (23.1)	15 (22.7)	
Smoking	103 (55.4)	39 (59.1)	0.34
DM	63 (33.9)	36 (54.5)	0.03
HTN	56 (30.1)	33 (50.0)	0.04
IHD	29 (15.6)	12 (18.2)	0.22
ECG before PCI			
Anterior	108 (58)	42 (63.6)	0.06
Inferior	69 (37)	24 (36.4)	
Others	9 (5)	0	
Killip class			
I	130 (71)	45 (68.2)	0.19
II	36 (19.7)	18 (27.3)	
III	11 (6)	3 (4.5)	
IV	6 (3.3)	0	
Ischemic time (h)	6.6±6.16	4.66±2.36	0.04

*Data were expressed in the form of mean (SD) and frequency (percentage). CKD, chronic kidney disease; DM, diabetes mellitus; HTN, hypertension; IHD, ischemic heart disease; MVD, multivessels disease; PCI, percutaneous coronary intervention.

Table 2 In-hospital outcome of both groups

	PPCI group (*n*=186) [*n* (%)] and (mean±SD)	Group streptokinase (*n*=66) [*n* (%)] and (mean±SD)	*P*
In-hospital mortality	16 (8.6)	12 (18.18)	0.032*
EF by simpsons	51.20±9.19	46.7±7.61	<0.001**

Independent samples *t*-test and χ^2-test. EF, ejection fraction. *Statistically significant difference (*P*<0.05). **Highly statistically significant difference (*P*<0.01).

atherosclerosis in patients with AMI. This is found to be in agreement with many earlier findings reported by Rajan *et al.* [4] This is most probably owing to estrogen protective effects in preventing atherosclerosis, which has been frequently highlighted in previous studies.

Smoking was found to be the most noticeable modifiable risk factor between our patients, and this is also similar to other findings reported by Christus and colleagues and Weinberger and colleagues, which highlighted increased rates of smoking among patients who presented with AMI. This could be explained by the fact that smoking enhances atherosclerosis, as it instigates endothelial dysfunction and promotes process of thrombosis and vasoconstriction of coronary even in normal coronary vasculature [5].

It has been found in our study that in-hospital mortality was highly significant in group B than group A. This is concordant with the published data by Stenestrand *et al.* [1], who included 26205 patients with STEMI who underwent reperfusion therapy within fifteen hours of the onset of symptoms. The patients were divided into three groups: the first group included patients treated by PPCI, the second group included patients who received in-hospital thrombolytic, and a third group of patients received prehospital thrombolytic. They found that 7-day mortality after MI was higher in patients who received in-hospital thrombolytic than patients who were treated by PPCI (8.8 vs 3.5%).

Our results are concordant with a meta-analysis reported by Nallamothu *et al.* [6], which concluded that lower rates of stroke, reinfarction, and further need for revascularization are associated with PPCI than fibrinolytic therapy. Moreover, a meta-analysis reported by Terkelsen *et al.* [7] highlightened the preferentiality of PPCI, as there was an absolute risk reduction in mortality for patient of STEMI treated by PPCI other than fibrinolysis.

Recently, Peiyuan *et al.* [8] found similar results when they analyzed 3082 patients, where one thousand patients had PPCI, 160 patients had fibrinolysis, and 1922 patients had neither PPCI or fibrinolysis, and it was found that the death rates were 7.7, 15.0, and 19.9%, respectively ($P < 0.001$). Patients with PPCI also had lower cardiac arrest, mechanical complications, and heart failure rates compared with fibrinolysis and no reperfusion ($P < 0.05$).

By echocardiography in our study, the mean predischarge LVEF by Simpsons in group A (51.20 ± 9.19) was statistically higher than that in group B (46.7 ± 7.61), which is discordant with published data by Bueno *et al.* [9] in 2011, where 266 patients with acute MI were randomized into 132 to PPCI and 134 to fibrinolysis. In that study, they found that predischarge LVEF was higher in group of fibrinolysis, as EF greater than 50% was found in 61 (45.5%) patients vs 47 (35.6%) patients in PPCI group, and this may be explained owing to the higher percentage of anterior MI presentation between PPCI group, with 64 (48.5%) patients, whereas anterior MI presented in 56 (41.8%) patients of fibrinolysis group.

Conclusion

The implementation of PPCI service is highly beneficial in patients of AMI in reducing in-hospital mortality and reinfarction.

PPCI is preferred as a strategy in the treatment of patients who presented with acute MI.

The rising public awareness of the role of smoking and addiction in this group of patients is of paramount importance for social security of our society.

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Conflicts of interest

There are no conflicts of interest.

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