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Comparison of left ventricular systolic function between diabetic and non-diabetic patients undergoing percutaneous coronary intervention in non-ST-elevated myocardial infarction by 2D and speckle tracking echocardiography

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Abstract
Background: NSTEMI is a primary reason for mortality and morbidity globally. This work was aimed at comparing LV systolic function utilizing 2D and speckle tracking echocardiography among diabetics and non-diabetics going through percutaneous intervention in NSTEMI.
Methods: our prospective randomized clinical study involved 100 individuals with acute NSTEMI clinical criteria going through PCI. Participants went through a categorization into two equal groups: Group 1: Diabetic patients. Group2: Non-diabetic patients. All patients were subjected to Electrocardiogram, Echocardiography and Primary PCI. Evaluating Left ventricular systolic function was done by 2D and speckle tracking Echocardiography.
Results: ejection fraction (EF) was significantly improved after 3 months compared to EF on admission within all groups (p<0.001). LVESV after 3 months, LVidS on admission were significantly greater within group I as opposed to group II (p =0.013). LVESV, LVidS and GLS were significantly decreased after 3 months compared to on admission within all groups (p<0.001). FS was significantly increased after 3 months compared to FS on admission within all groups (p<0.001). GLS on admission was significantly less within group II as opposed4 to group I (p =0.037).
Conclusions: For diabetics having NSTEMI and going through PCI, EF by 2D echocardiography and GLS by Speckle tracking echocardiography were significantly decreased than non-diabetic patients. The policy makers must provide a sustainable solution to reduce the overexploitation of forest resources.

Keywords: Left ventricular systolic function, percutaneous coronary intervention, non-ST- elevated myocardial infarction, 2d speckle tracking echocardiography

Introduction
NSTEMI represents a primary reason for mortality and morbidity globally [1, 2]. Diabetes mellitus is a condition characterized by metabolic dysfunction, causing disrupted glucose metabolism, followed by distinct as well as prolonged consequences. It is linked to particular conditions, involving retinopathy as well as neuropathy. Individuals diagnosed with any type of diabetes, whether it was insulin-dependent (IDDM) or non-insulin dependent (NIDDM) for an extended period, have greater chances to develop such consequences, resulting in severe morbidity.
Most of the patient undergoing coronary revascularization are diabetic due to progression of atherosclerosis [3-5]. Diabetics having NSTEMI acute coronary syndrome have greater chances of developing frequent cardiovascular events [6]. Transthoracic 2D echocardiography is a modality for assessment left ventricular function prior to as well as following percutaneous intervention among diabetics and non-diabetics [7].
It has been demonstrated that speckle tracking echocardiography provides more information that allows non-invasive measurement of allover LV strain and twist [8].

This work was aimed to comparing left ventricular systolic function utilizing 2D and speckle tracking echocardiography among diabetics and non-diabetics going through percutaneous intervention for NSTEMI.

Patients and Methods

Our prospective randomized clinical study involved 100 individuals, whose ages are above 18, both sexes, having acute NSTEMI. Patients undergoing coronary intervention angiography, diabetics (NIDDM) as well as non-diabetics. It was approved by the Ethics Committee of Faculty of Medicine, Tanta University, Egypt. All participants were asked to fill an informed consent.

Exclusion criteria were valvular heart disease, cardiomyopathy, congestive heart failure, chronic kidney disease, atrial fibrillation, congenital heart diseases, chronic stable angina, unstable angina, ST- elevated myocardial infarcation (STEMI).

All participants went through a categorization into two equal groups: Group 1: Diabetics having NSTEMI going through PCI assessment. Group 2: Non-diabetics having NSTEMI going through PCI.

All participants went through a comprehensive medical history, clinical examinations involving systolic, diastolic BP measurements as well as HR, laboratory testing, cardiac enzymes (CK MB-trponin I), lipid profile was involved (total cholesterol, LDL, HDL and triglycerides, as well as random blood sugar.

Electrocardiogram

Standard 12 leads electrocardiogram was done at admission.

Echocardiography

2D and speckle tracking echocardiography was done before and after percutaneous coronary intervention on admission and after 3 months.

Utilizing a specialized software package, we measured 2D strain to gather data regarding local myocardial functions as well as velocity. LV For speckle-tracking analysis, three cycles were captured at a frame rate of at least ≥ 45 frames per second (fps), as well as the mean value was measured for the strain analysis. The aortic valve opening and closing times were determined utilizing the LV outflow Doppler profile. These measurements were then incorporated into the speckle-tracking strain profile for any post-systolic components' exclusion.

Primary PCI

All participants will have a percutaneous coronary intervention for managing culprit lesions. Coronary angiograms will be digitally captured for quantitative analysis purposes.

Upon admission, the participant will be administered a single dosage of chewable aspirin 300 mg, as well as a loading dosage of either clopidogrel 600 mg or Ticagrelor 180 mg. Prior to the surgical procedure, a dosage of 70 U/kg of standard heparin will be delivered. Qualified interventional cardiologists will perform all PCI procedures via the femoral artery. Lesions will be passed utilizing guide wires with a diameter of.014 inches. Participants will be subjected to direct stenting, conventional stenting, or balloon dilation only, depending on their coronary anatomy as well as lesion characteristics. Following the intervention, a daily dosage of 75–150 mg of aspirin, as well as 75 mg of clopidogrel or 90 mg of Ticagrelor twice a day, will be given.

Statistical analysis

The data went through a statistical analysis utilizing SPSS (Statistical Package for the Social Sciences) version 25 (IBM Inc., Chicago, IL, USA). Shapiro-Wilks normality test as well as histograms were utilized for assessing the distribution of quantitative variables to determine the appropriate statistical testing type: parametric or nonparametric. Parametric variables (e.g., age) were displayed as mean and standard deviation and underwent a comparison utilizing F test among the three groups with post hoc (Tukey) test to compare each two groups. A paired T test was utilized for comparing two variables within the same group. Non-parametric variables, such as VAS, were displayed by their median and interquartile range (IQR) and underwent analysis utilizing the Kruskal-Wallis test. Additionally, a Mann-Whitney U test was utilized for comparing each pair of groups. The Wilcoxon test was utilized for comparing two variables within the same group. Categorical data, such as sex, were displayed as frequency and percentages and underwent analysis utilizing the Chi-square test. A two-tailed P value of 0.05 or less deemed to be statistically significant.

Results

Weight as well as BMI were significantly greater within group I as opposed to group II (p<0.001) while age, sex, as well as height were insignificantly different. Table 1

Table 1: Baseline characteristics of the studied groups

		Group I (n =50)	Group II (n =50)	p value
Age (years)		52.9 ± 6.14	50.94 ± 5.34	0.09
Sex	Male	39 (78%)	36 (72%)	0.645
	Female	11 (22%)	14 (28%)	
Weight (kg)		99.76 ± 8.42	89.5 ± 11.23	**<0.001***
Height (cm)		177.9 ± 7.75	179.14 ± 8.7	0.454
BMI (kg/m^2)		31.67 ± 3.59	28.03 ± 4.1	**<0.001***

Data is presented by Mean ± SD, SD: Standard deviation, BMI: Body mass index, *statistically significant as p value ≤0.05.

No significant variations were documented regarding Vital signs (SBP, DBP, and HR) between the studied groups. Table 2

Table 2: Vital signs of the studied groups

	Group I (n =50)	Group II (n =50)	p value
SBP (mmHg)	131.92 ± 10.24	129.32 ± 8.71	0.174
DBP (mmHg)	82.88 ± 12.52	79.44 ± 10.44	0.138
HR (bpm)	76.34 ± 10.79	78.92 ± 11.31	0.246

Data is presented by Mean ± SD, SD: Standard deviation, SBP: Systolic blood pressure, DBP: Systolic blood pressure, HR: Heart rate, bpm: Beat per minute.

Total cholesterol, LDL and RBG were significantly higher within group I as opposed to group II, but no significant variations were documented regarding HDL as well as triglycerides among both groups. Table 3

Table 3: Laboratory data of the studied groups

	Group I (n =50)	Group II (n =50)	p value
Total cholesterol (mg/dL)	212.79 ± 19.74	196.28 ± 11.51	<0.001*
LDL (mg/dL)	134.9 ± 20.19	117.36 ± 14.27	<0.001*
HDL (mg/dL)	49.68 ± 9.29	52.78 ± 10.94	0.129
Triglycerides (mg/dL)	141.06 ± 28.75	131.2 ± 28.67	0.089

Data is presented by Mean ± SD, SD: Standard deviation, LDL: Low-density lipoprotein, HDL: High density lipo-protein, RBG: Random blood glucose, *Statistically significant as p value ≤0.05.

No significant variations in ejection fraction (EF) were documented on admission between group I and group II, but EF after 3 months was significantly greater within group II as opposed to group I (p =0.005).

EF exhibited significant improvement after 3 months compared to EF on admission in all groups (p<0.001). Table 4

Table 4: Ejection fraction of the studied groups

	Group I (n =50)	Group II (n=50)	p value
EF on admission (%)	53.74 ± 3.34	55.24 ± 4.78	0.072
EF after 3 months (%)	57.12 ± 3.55	59.74 ± 5.36	0.005*
P value	<0.001*	<0.001*	

Data is presented by Mean ± SD, SD: Standard deviation, EF: Ejection fraction, *statistically significant as p value ≤0.05.

No significant variations regarding LVESV on admission, LVidS after 3 months, FS on admission or after 3 months and GLS after 3 months were documented among all groups, but LVESV after 3 months, LVidS on admission were significantly greater withn group I as opposed to group II (p =0.013). LVESV, LVidS and GLS were significantly decreased after 3 months compared to on admission among all groups (p <0.001). FS was significantly increased after 3 months compared to FS on admission among all groups (p <0.001). GLS on admission was significantly less within group II as opposed to group I (p =0.037). Table 5

Table 5: Left ventricular end systolic volume, internal diameter, fractional shortening and speckle tracking echocardiography of the studied groups

	Group I (n =50)	Group II (n =50)	p value
LVESV on admission (mL)	44.02 ± 2.96	42.84 ± 3.4	0.067
LVESV after 3 months (mL)	33.64 ± 4.37	31.44 ± 4.38	0.013*
P value	<0.001*	<0.001*	
LVidS on admission (mm)	35.82 ± 5.4	32.62 ± 4.81	0.002*
LVidS after 3 months (mm)	32.62 ± 5.7	30.62 ± 4.84	0.062
P value	<0.001*	<0.001*	
(%) FS on admission	23.28 ± 2.07	23.6 ± 2.11	0.446
(%) FS after 3 months	27.28 ± 2.73	27.86 ± 2.43	0.265
P value	<0.001*	<0.001*	
(%) GLS on admission	-12.11 ± 2.72	-12.97 ± 0.94	0.037*
(%) GLS after 3 months	-15.04 ± 2.91	-15.88 ± 1.58	0.076
P value	<0.001*	<0.001*	

Data is exhibited by Mean ± SD, SD: Standard deviation, LVESV: Left ventricular end systolic volume, LVidS: Left ventricular internal diameter at end systole, FS: Fractional shortening, *statistically significant as p value ≤0.05.

Discussion

Since an enhanced LV systolic function is linked to improved outcomes as well as functional capacity, DM presence did not detrimental impact on improving LVEF following angioplasty [9].

Speckle LV generated tracking Global longitudinal strain (GLS) represents a reliable method of quantifying the LV functions following STEMI. Additionally, it exhibits more sensitivity when compared with the LVEF 2D echocardiographic evaluation [10].

Our study revealed, regarding 2D echocardiography data; no significant variations in EF on admission were documented however, after 3 months EF was significantly greater within non-diabetics as opposed to diabetics (p =0.005).

Similarly, El din Elrabat *et al*. **[11]** conducted a cross sectional, comparative study on 100 individuals (fifty diabetics as well as fifty non-diabetics) who had first attack anterior STEMI mamaged by primary PCI. They addressed no significant variations regarding EF on admission however, within a 3-months period, EF was significantly greater within non-diabetic group as opposed to diabetic one.

However, Salama *et al*. [12] addressed, there was a statistically significant variations regarding EF within first days following NSTEMI (P value 0.002) however, within a 6-weeks period following NSTEMI early intervention, this difference was statistically insignificant among diabetic group as well as non-diabetic control one (P value 0.38).

As opposed to our findings, Chowdhury *et al*. **[13]** revealed that before PCI, at baseline LVEF was less within diabetics as opposed to non-diabetics. However, within a three-months period following PCI, LVEF enhanced 8.4±1.2% in diabetics and 7.9±1.2% in non-diabetics, yet this improvement variation among both groups was not statistically significant (p = 0.631).

In our findings, no significant variation regarding LVESV on admission was documented however, LVESV after 3

months was significantly higher within diabetics as opposed to non-diabetics(p =0.013 and 0.002 respectively).

These results were also observed by Chowdhury *et al*. [14] who performed comparative clinical study to identify the LV systolic activity changes following successful PCI within NSTEMI diabetics, then comparing it with non-diabetics. About 30 diabetics as well as 34 non-diabetics having NSTEMI going through percutaneous coronary intervention were involved. They addressed that at baseline the LVESV exhibited no variations among both groups. However, LVESV within a three-months period was significantly greater within diabetics as opposed to non-diabetics.

Similarly, El din Elrabat *et al*. [11] found that LVESV after 3 months greater within diabetics as opposed to non-diabetics.

Our result aligned with Chowdhury *et al*. [13] reporting no significant variation in LVESV at baseline however, LVESV after 3 months was significantly higher within diabetics as opposed to non-diabetics (p = 0.017 and p = 0.008 respectively).

Regarding our study's results, LVidS on admission was significantly greater within diabetics as opposed to non-diabetics however, no significant difference regarding LVidS after 3 months was documented between both groups.

These results were also observed by Chowdhury *et al*. **[14]** who found that after 3 months, there was no significant enhancement observed in either in diabetic and non-diabetic groups post PCI in terms of LVIDs.

Similarly, Salama *et al*. [12] found that regarding the LVidS during first day of NSTEMI, the mean within diabetics was 42.47, while non-diabetics exhibited 38.41 that deemed to be statistically significant (P value 0.017). Concerning the LVidS 6-weeks period following early intervention for NSTEMI, no significant variation was documented (P value 0.132) between both groups.

Similarly, Salama *et al*. [12] found that there was no significant difference in FS on admission and after a six-months period between the diabetics as well as non-diabetics.

Collectively, our results presented that EF and FS after 3 months were significantly increased after 3 months compared to EF and FS on admission in diabetic and non-diabetic groups, but LVESV and LVidS after 3 months were significantly decreased after 3 months compared to LVESV and LVidS on admission in both groups.

Our result was in agreement with Chowdhury *et al*. [13] who found that EF after 3 months was significantly greater as opposed to EF on admission within both groups, but LVESV and LVidS after 3 months were significantly decreased after 3 months compared to LVESV and LVidS on admission in both groups.

In our results, GLS on admission was significantly lower in non-diabetic group as opposed to diabetic group (p =0.037) but no significant variation regarding GLS after three months among the studied groups.

These results were also observed by Rashid *et al*. [15] who found that GLS was significantly lower within non-diabetics as opposed to diabetics. The P-value was (less than 0.001).

Similarly, Salama *et al*. [12] found that concerning the GLS within the first day of NSTEMI for non-diabetics was considerably lower than in diabetics (P value 0.002) but no significant variation regarding GLS after 6 months was documented between the studied groups.

In our results, GLS was significantly decreased after 3 months compared to on admission readings in diabetic and non-diabetic groups ($p<0.001$).

Aligned with our results, Salama *et al*. [12] found that GLS was significantly decreased after 6 months compared to on admission readings in diabetic and non-diabetic groups ($p<0.001$). Similarly, El din Elrabat *et al*. [11] found that GLS was significantly decreased after 3 months compared to on admission readings in diabetic and non-diabetic groups.

Limitation: modest sample size, a single-centered study, short follow up periods, not all parameters of the LV systolic function evaluation were assessed, as well as we did not cardiac MRI in our study.

Conclusions

In diabetics having NSTEMI and going through percutaneous intervention, EF by 2D echocardiography and GLS by Speckle tracking echocardiography were significantly decreased than non-diabetics.

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Conflict of Interest: Nil.

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