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Impact of Diabetes Mellitus on Global Longitudinal Strain in STEMI Patients Underwent Successful Reperfusion Using Speckle Tracking ECHO during Hospital Stay

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Abstract

In this research, the effects of diabetes Milletus on the globally longitudinal strain (GLS) after ST-Segment Elevation Myocardial Infarction (STEMI) have been successfully refilled in patients throughout the period of hospital stay with the use of Speckle Tracking ECHO (STE). Methods: This trial comprised 60 patients, each group was allocated sequentially when they fulfilled the research inclusion criteria; Group (I):- which included 32 individuals with DM history or the use of oral anti-diabetic or insulin medicinal medicines or HbA1c #6.5). Methods: This group of patients is then grouped into Group (A):- containing 23 controlled DM patients (HbA1c < 7), Group (B):- including 9 un-controlled DM patients (HbA1c < 7). Then the group will be grouped into Group (A). Group (II):- Including 28 individuals without DM history, using antidiabetic medication or HbA1c < 6.5). Results & Schlussfolgerungen: GLS (GLS= -12.4) in those with managed diabetes (HbA1c < 7) was significantly greater than (GLS= -10.5) in those with uncontrolled diabetes (HbA1c = 7) in patients. The P-value was less than 0.001. GLS offers an appropriate, quick, easily accessible and reliable technique for LV dysfunction evaluation which may precede the functional changes observed with traditional 2D echocardiography. Higher levels of HbA1c linked with greater prevalence of LV dysfunction in diabetic patients, sessed by GLS derived speckling monitoring, even in individuals with successful reperfusion. Echocardiography.

Keywords: Diabetes Mellitus, STEMI, Reperfusion, Speckle Tracking, ECHO.

1. Introduction

Mellitus diabetes (DM) refers to a set of common metabolic diseases which share the hyperglycemia phenotype. DM-related metabolic dysregulation generates secondary pathophysiological alterations in many organ systems that place a huge load on diabetic patients and the healing system. [1]

A variety of cardiovoscular consequences is linked with diabetes mellitus, such as increased incidence of atherosclerotic coronary artery disease, myocardial infarction, congestive heart failure, coronary microangiopathy, systemic blood pressure and cardiomyopathy. [2]

ST-level myocardial infarction (STEMI) is one of the most prevalent diseases that has serious medical complications and, if ignored, is an important health issue. Myocardial injury occurred soon after STEMI results in many chemical and mechanical alternations in the left ventricular (LV) structure that may result in alterations in the shape and volumes of LV that ultimately lead to heart failure[3].

Given the above, thorough initial and follow-up assessment of myocardial function is an essential clinical aspect in any therapeutic process, particularly after myocardil infarction. An evaluation of the LV systolic function is one of the well-known markers for determining the prognosis of AMI patients[4].

Echocardiography is a helpful technique for stratification and pronostic evaluation after an Acute Myocardial Infarction to address these issues (AMI).

Several echocardiographic measures were found to offer predictive information, e.g. LV volume, EF, Wall Motion Score Index (WMSI).[5] Value and EF are the main methods of evaluating myocardial and systolic function following AMI. It should however be borne in mind that these indexes are global, depending on load and susceptible to observation and expertise. [6]. Speckle LV generated tracking GLS is regarded an effective measure of quantification of the left-ventricular post-STEMI function, and is more sensitive than the 2D echocardiographic assessment of LVEF[7].

The objective of this research was to clarify the effects of diabetes milletus on Global Longitudinal Strain (GLS) in patients with ST-segment Elevation Myocardial Infarction (STEMI) during Hospital Stay.

2. Patients and methods

This prospective research included sixty patients hospitalised to the National Heart Institute (NHI) Cardiology Department, Benha University Hospital and Coronary Care Unit from April 2019 to March 2021. We intend to assess the Global Lengthitudinal Strain (GLS) in diabetes patients utilising ECHO Speckle Tracking (STE) vs. Non diabetic individuals after ST segment Elevation Myocardial Infarction (STEMI).

The research was authorised by our institution's local ethics committee, and patients had to give informed permission prior to echocardiographic testing.

Criteria for inclusion

Patients with first time ST-Segment uplift Myocardial Infarction (STEMI) with start symptoms less than 12 hours of effective treatment, either in the first 12 o'clock from symptom onset, or in the first 24 hours after primary PCI commencement. The patients with STEMI were those suffering from typical myocardial infarction thoracic chest pain with an elevation of the ECG of at least 30 minutes and under 12 hours at the point J of a new ST segment in two adjacent lines with a reduction point of up to 0.1mV in all lines of the 12-lead ECG other than V2 and V3 with a cut-off point of up to 0.2mV in men < 40years; 0.25mV in men < 40 years; or <40years or > All patients were eligible for reperfusion treatment, as per local guidelines (PPCI or fibrinolysis). Included patients must have successful reperfusión defined as the loss of or significant relief of chest pain with ST-segment resolution, with a lead elevation of more than 70 per cent with a maximum baseline elevation of ECG performed 90 minutes since fibrinolytic treatment or soon after successfully restoring the TIMI (II to III) coronary angiogram fluency, with successful PPCI resolution.

Exclusion criteria

- Patients with pre existing cardiomyopathy.
- Moderate and severe valvular heart disease.
- Age younger than 18 years.
- Bad echocardiographic windows.
- Patients with late presentation after symptom onset (more than 12 hours from onset of chest pain).
- Patients with failed reperfusion (assessed by ST-segment resolution less than 50%, persistent chest pain)
- Patients with atrial fibrillation, paced rhythms or other conditions that may hamper the quality of obtained echocardiographic data.

On admission all patients were subjected to full history taking, complete clinical examination and Laboratory investigation: Random blood sugar for assessment of blood sugar level and status of DM Control.

Echocardiography (within 24hrs after successful reperfusion):

Patients were imaged in the left lateral decubitus position using a commercially available ultrasound system (Philips EPIQ 7 Ultrasound System) equipped with 3.5 MHz phased-array transducer. Standard 2D images triggered to the QRS complex, were saved in cine loop format according to the guidelines of the American Society of Echocardiography

We divided our patients into 2 main groups:

Patients were assigned to each group sequentially if they met the inclusion criteria of our study :-

- **Group (I) :-** Which included 32 subjects with History of DM or taking oral anti diabetic drugs or insulin or HbA1c ≥6.5). then this group of patients subdivided into;-
  - ❖**Group (A)** :- including 23 patients with controlled DM (***patients with HbA1c < 7)***
  - ❖**Group (B)** :- including 9 patients with uncontrolled DM (**patients with HbA1c** ≥7)
- **Group (II) :-** Which included 28 subjects without History of DM nor taking anti diabetic drugs or HbA1c < 6.5).

Statistical analysis

Data management and statistical analysis were done using SPSS version 25 (IBM, Armonk, New York, United States). Quantitative data were assessed for normality using Kolmogorov–Smirnov test (in the whole study population), Shapiro-Wilk test (in diabetics or non-diabetics), and direct data visualization methods. Numerical data were summarized as means and standard deviations. Categorical data were summarized as numbers and percentages. Quantitative data were compared between diabetics and non-diabetics using independent t-test. Categorical data were compared using the Chi-square test or Fisher's exact test, if appropriate. Correlation analysis was done between GLS and other parameters using Pearson's correlation. ROC analysis was performed for GLS in the prediction of uncontrolled diabetes Area Under Curve (AUC) with 95% confidence interval, It showed an excellent AUC of 0.882 with a 95% confidence interval ranged from 0.765 to 0.998 (P-value < 0.001). The best cut-off point was ≤ 11.5, at which sensitivity and specificity were 100% and 73.9%, respectively, best cutoff point, and diagnostic indices were calculated. All statistical tests were two-sided. P values less than 0.05 were considered significant.

3. Results

Sixty patients were included in this study there mean age 51 years, Regarding gender, 34 patients were female representing more than half of the studied patients (56.7%) , 26 patients were males (43.7%) Approximately two-thirds of the studied patients were smokers (66.7%). More than one-third of the patients were hypertensive (45.0%), and more than half were dyslipidemic (55.9), about one-third (30.0%) showed a positive family history of premature CAD. No obesity, No past history of IHD, nor PCI were reported in the studied patients. Table (1)

Table (1) General characteristics in the studied patients and according to diabetes

		Total (n = 60)	**Group (I) (n = 32)**	**Group (II) (n = 28)**	**P- value**
Age (years)	Mean	51	51	50	0.738
	Males n (%)	26 (43.3)	1ʌ (56.2)	8 (28.6)	0.031*
Sex	Females n (%)	34 (56.7)	14 (43.8)	20 (71.4)	0.069
Smoking	n (%)	40 (66.7)	18 (56.3)	22 (78.6)	0.067
Hypertension	n (%)	27 (45.0)	17 (53.1)	10 (35.7)	0.176
Dyslipidemia	n (%)	33 (55.9)	18 (58.1)	15 (53.6)	0.728
F/H of premature CAD	n (%)	18 (30.0)	12 (37.5)	6 (21.4)	0.175

Independent t-test was used for numerical data. Chi-square test was used for categorical data. **IHD;** Ischemic heart disease **PCI;** Percutaneous Coronary Intervention

There were no significant differences regarding all general characteristics of both two groups, except for gender; male gender was significantly higher in Group (I) (56.3%) than Group (II) (28.6%). P-value was (0.031). fig.(1)

Anterior location was the most frequent STEMI location (61.7%), while the lateral location was the least frequent (10.0%). Most patients (86.7%) underwent PPCI as a method of reperfusion. Only 13.3% received SK. The majority of the patients (91.7%) had an ST resolution of ≥ 70%. Only 8.3% had an ST resolution of ≥ 50%. About two-thirds of the patients had LAD affection (61.7%), one-quarter had RCA affection, and only 13.3% had LCX affection. table (2)

The mean EF was 50.1%. The mean LVEDV and LVESV were 86.4ml and 43.2 ml, respectively. The mean SWMI was 1.486. Regarding GLS, the mean was -12.9%. Table (3)

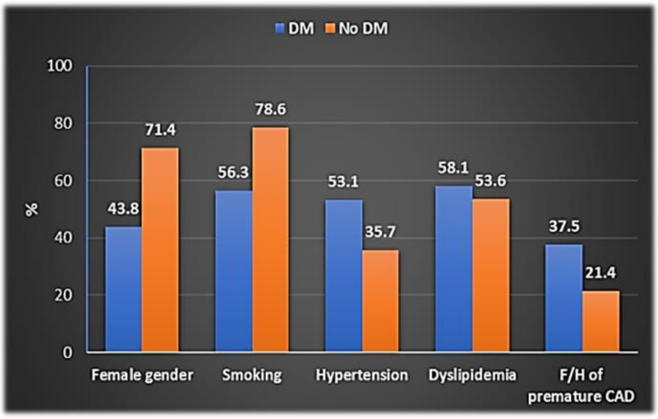

Fig. (1) General characteristics according to diabetes.

Table (2) STEMI characteristics in the studied patients and according to diabetes

			Total (n = 60)	Group (I) (n = 32)	Group (II) (n = 28)	P-value
STEMI location	Anterior	n (%)	37 (61.7)	21 (65.6)	16 (57.1)	
	Inferior	n (%)	17 (28.3)	9 (28.1)	8 (28.6)	
	Lateral	n (%)	6 (10.0)	2 (6.3)	4 (14.3)	0.566
Methods of reperfusion	PPCI	n (%)	52 (86.7)	25 (78.1)	27 (96.4)	
	SK	n (%)	8 (13.3)	7 (21.9)	1 (3.6)	0.057
ST resolution	≥ 70%	n (%)	55 (91.7)	30 (93.8)	25 (89.3)	
	≥ 50%	n (%)	5 (8.3)	2 (6.3)	3 (10.7)	0.657
Culprit vessel	LAD	n (%)	37 (61.7)	21 (65.6)	16 (57.1)	
	LCX	n (%)	8 (13.3)	2 (6.3)	6 (21.4)	
	RCA	n (%)	15 (25.0)	9 (28.1)	6 (21.4)	0.221

PPCI; Primary Percutaneous Coronary Intervention **SK;** Streptokinase **LAD;** Left anterior descending arter **LCX;** Left circumflex artery **RCA;** Right coronary artery Chi-square or Fisher's exact test was use.

Table (3) Echo characteristics in the studied patients and according to diabetes

		Total (n = 60)	Group (I) (n = 32)	Group (II) (n = 28)	P-value
EF (%)	Mean ±SD	50.1 ±5.7	48.8 ±3.9	51.6 ±7.1	0.074
LVEDV (ml)	Mean ±SD	86.4 ±20.9	89 ±20.5	83.4 ±21.4	0.303
LVESV(ml)	Mean ±SD	43.2 ±12.7	45.6 ±12	40.5 ±13	0.115
SWMA	Mean ±SD	1.486 ±0.24	1.517 ±0.242	1.451 ± 0.237	0.286
GLS (%)	**Mean ±SD**	**-12.9 ±2.3**	**-11.9 ±1.5**	**-14.1 ±2.5**	**<0.001**

EF; Ejection fraction **LVEDV**; LV end-diastolic volume **LVESV**; LV end-systolic volume **SWMA;** segmental wall motion abnormality **GLS;** Global longitudinal strain **Independent t-test was used**

Correlation between GLS and Echo parameters shown in table (4)

Table (4) Correlation between GLS and Echo parameters

	GLS	
	r	**P-value**
Age (years)	-0.125	0.339
EF (%)	**0.295***	0.022
LVEDV (ml)	-0.088	0.504
LVESV(ml)	-0.192	0.142
SWMI	-0.179	0.172

Pearson's correlation was used *** Significant**

EF; Ejection fraction **LVEDV;**LV end diastoli volume **LVESV**; LV end-systolic volume

SWMA; segmental wall motion abnormality **GLS;** Global longitudinal strain.

Correlation between GLS and Diabetes control status shown in table (5).

Table (5) GLS according to diabetes control status

		Group (A) (n = 23)	Group (B) (n = 9)	P-value
GLS (%)	Mean ±SD	-12.4 ±1.4	-10.5 ±8	**<0.001**

Independent t-test was used **GLS**; Global longitudinal strain

GLS was significantly higher (GLS= -12.4) in those with controlled diabetes (**patients with HbA1c < 7**) than (GLS= -10.5) those with uncontrolled diabetes (**patients with HbA1c** ≥7) . The P-value was <0.001. figure 2

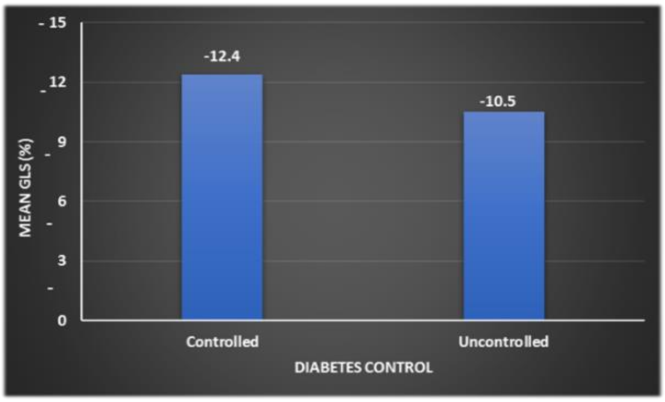

Fig. (2) GLS according to diabetes control status

4. Discussion

There were no significant differences in any baseline general characteristics between diabetes and non-diabetic individuals

This is comparable to Araszkiewicz et al. [8] who demonstrated that there is no significant variation in baseline clinical features between diabetic and non-diabetic individuals.

According to our research, Ersbøll et al.[9], whose study group was much bigger and almost similar to our own, did not find any statistically significant difference in the baseline characteristics of the study population.

Regarding the features of STEMI our research revealed substantial disparities between individuals who are diabetes and non-diabetic. STEMI's location on the basis of ECG was not relevant either.

Similar to Ammar M et al. [10], which revealed no substantial variation in STEMI features between diabetic and non diabetic individuals

In our research, the Global Longitudinal Strain (GLS) in non-diabetics was considerably greater than in diabetics (-11.9 ±1.5). The P-value was less than 0.001.

We also follow Zoroufian A& Razmi T[21] who assesses subclinical left ventricular dysfunction in diabetic patients with longitudinal strain by using 2-dimensional speckle-tracing echocardiography, and conclude that the segmental and global end-systolic longitudinal strain in diabetic patients with normal coronary and expulsion fractions decreased. These findings indicate that alterations in the systolic function may be detected early in the natural course of STE research diabetes mellitus.

Our findings were also in agreement with Danielle Shepherd, et al.,[12] who evaluated longitudinal strain in individuals with Type I diabetes mellitus by speckle tracking. The results suggest that myocardial strain evaluations may effectively identify early contractile changes that may precede functional abnormalities seen by traditional M-mode echocardiography.

In the present trial, the baseline baseline systemic function LV measured with a speckle-tracking strain was reduced by first STEMI patients when compared with non-diabetical patients, whereas there was no significant difference between the same patients with other conventional 2D ECHO parameters (EF percent), LVEDV, LVESV, and WMSI.

We agreed with Araszkiewicz et al.[8] who observed that the difference between LVEDV, LVESV, EF or WMSI was statistically significant.

Also, Shah et al. [13] concurred that no difference in variations in LV and LVEF volumes from the baseline to 1 month and 1 to 20 month follow-up between patients with or without diabetes was seen in the research VALIANT Echo.

In this research, we connect echocardiogram using conventional echocardiography indexes with the Global Longitudinal Strain (GLS). LVEF, LVEDV, LVESV and WMSI in patients under study.

We discovered that GLS had a substantial positive association with EF in our research (r=0.295 & P-value=0.022). Between GLS and other parameters there were no significant relationships.

These results correspond with Cimino et al.,[7] who examined 2D-STE in 20 STEMI patients for globally and regional longitudinal strain (GLS-RLS) and found that GLS had a substantial 2D-echo LVEF-evaluated association.

We also agreed with Nisha et al.[14], who compared GLS with other non-invasive imaging methods in 163 STEMI patients in assessing LV function. They discovered that the global strain is well linked to EF assessed in various ways. The global strain was shown to be the best low EF predictor assessed by the gold MRI standard. As the global strain is a cheap test, these data may be of economic importance to health.

In our research, GLS (-12.4) was substantially greater in individuals with managed diabetes (diabetic HbA1c < 7) than in those with uncontrolled diabetes (-10.5) (diabetic HbA1c <7)

The P-value was less than 0.001.

These results are consistent with Zhang et al.[15] who found that there was a substantial difference between the controlled DM group and the noncontrolled DM group and that Poor Blood Glucose Check as defined in HbA1c — 7 per cent— leads to a reduction of LV systolic strain in all direction, independently associated with preclinical strains. These results are consistent with Zhang et al.[15]

5. Conclusion

GLS offers an appropriate, quick, easily accessible and reliable technique for LV dysfunction evaluation which may precede the functional changes ob-served with traditional 2D echocardiography. Higher levels of HbA1c linked with greater prevalence of LV dysfunction in diabetic patients, sessed by GLS derived speckling monitoring, even in individuals with successful reperfusion. Echocardiography.

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