ORIGINAL ARTICLE

THE PREFERENCE OF USING GLOBAL LONGITUDINAL STRAIN SPECKLE TRACKING ECHO STUDY OVER MEASUREMENT OF LEFT VENTRICLE EJECTION FRACTION (LVEF) IN THE EARLY DETECTION OF SUBCLINICAL SYSTOLIC DYSFUNCTION IN DIABETIC PATIENTS

DOI: 10.36740/WLek202112113

Ali Hassan[1], Karim O. Al Naffi[2]
[1]AL HUSSAIN MEDICAL CITY, KARBALA, IRAQ
[2]KARBALA COLLEGE OF MEDICINE, IRAQ

ABSTRACT

The aim: Prove that the use of GLS by speckle tracking ECHO study is more sensitive to detect early systolic dysfunction.

Materials and methods: In this case control study 40 diabetic patients 22 males (55%) & 18 females (45%) who have no symptom or clinical finding of a cardiac problem with normal LVEF and a 30 healthy control subjects. The ECHO study includes measuring their LVEF &comparing it with the result global longitudinal strain by speckle tracking for assessment of systolic function.

Results: A 62.5% of diabetic patients who are have no CVS complaint neither they have systolic dysfunction with normal LVEF they have early systolic dysfunction revealed by speckle tacking technique in compares to a healthy control group where only 10% have systolic dysfunction with mean GLS of the patients was -17.43±3.016, while that for the control group -20.58 ± 1.729 A P value of 0. 012. Also there is a significant correlation between the duration of DM & the systolic dysfunction as detected by GLS.

Conclusions: Diabetic patients got early systolic dysfunction before they show any symptoms, even their LVEF is normal, which can be detected by speckle tracking ECHO study.

KEY WORDS: Diabetes, systolic dysfunction, speckle tracking, global longitudinal strain

Wiad Lek. 2021;74(12):3195-3198

INTRODUCTION

Diabetes mellitus can affect the heart through different mechanisms, from a defect in the large blood vessels (microvasculature), as it accelerates atherosclerosis and the small blood vessels (microvasculature) [1-2] to cellular and molecular mechanisms as myocardial fibrosis and myocytes hypertrophy [3-4]. Although the pathogenesis of diabetic cardiomyopathy is believed to be multifactorial but with the exact cause remaining unknown, several mechanisms such as hyperglycemia and hyperinsulinemia have been reported to play an important role in its etiology [5-7]. The spectrum of diabetic heart disease involves a progression from the normal heart, to preclinical LV diastolic and systolic dysfunction (detectable only with advanced imaging techniques), followed by conventional echocardiographic evidence of LV dysfunction (still clinically silent) and finally symptomatic heart failure [8]. Echocardiography is gold standard modality for assessment of cardiac function, whether systolic &diastolic function, by using several technique as M-Mode, 2-D or Tissue Doppler, but because of the complicity of the cardiac contractility which occurs in three planes namely longitudinal, circumferential &radial there is limitation to properly assess the systolic function which riles on the measurement of LVEF only [9]. The presence of impaired longitudinal function in diabetic patients has been reported when using tissue Doppler imaging[9]. However, TDI has many limitations. It is fairly complex to analyze and interpret, only modestly robust and frame rate and in particular angle dependent. Assessment of deformation parameters by TDI is thus only feasible if the echo beam can be aligned to the vector of contraction in the respective myocardial segment [10]. So what we got as normal LVEF & S wave does not reflect the real systolic function of the heart. The recent development of 2D speckle tracking echocardiography (STE) &measurement of Global longitudinal strain overcomes some of these limitations & can detect early LV systolic dysfunction, even if the patient is asymptomatic &have normal LVEF by the other ECHO modality measurements. Radial, circumferential, and longitudinal strains are the three natural deformations that can be measured with 2Dspeckle tracking [10]; however, LV global longitudinal strain (GLS) provides the best evidence on the diagnostic and prognostic implications. LV GLS is expressed as a negative value because it represents the shortening of the myocardium relative to the original length. More negative the LV GLS is, the better the LV systolic function. The normal range for global longitudinal strain was 18.6 -21%, although it significantly varied with age, yet no global consensus about cut value, therefore, any value of LV GLS less negative than -20% could be considered pathological [11-12].

Table I. The mean and standard deviation of the main markers among diabetic patients and controls

Parameter	Diabetic patients (n=40)	Control subjects (n=30)	P-value
BMI	28.94 ± 5.8	26.87 ±3.929	0.062
LVEF MM	62.98 ±5.328	66.23 ± 4.695	0.062
LVEF Simpson	59.18 ± 5.500	62.40 ±4.239	0.096
S' velocity (cm/s)	0.101± 0.0194	0.1006 ±0.0159	0.849
GLS	-17.433 ± 3.0158	-20.583 ± 1.729	0.012

*BMI=Body mass index, LVEF=left ventricular ejection fraction, MM=M-mode, GLS=Global longitudinal strain, S' velocity=positive velocity in systole

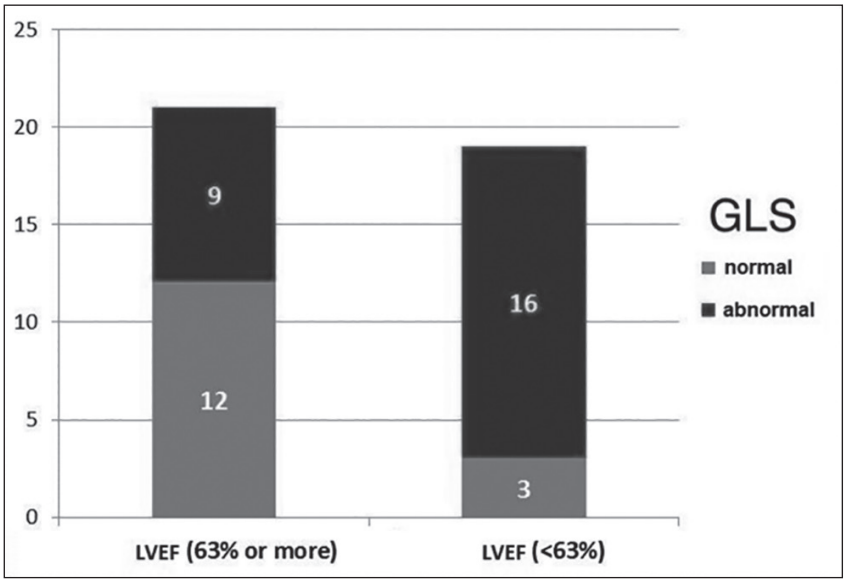

Fig 1. Relation between GLS and LVEF

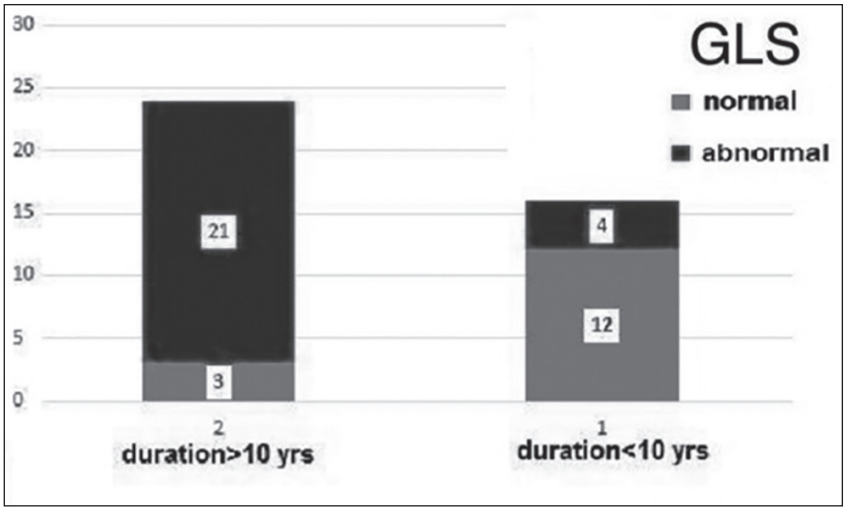

Fig 2. The relation between GLS &duration of DM

THE AIM

Prove that the use of GLS by speckle tracking ECHO study is more sensitive to detect early systolic dysfunction.

MATERIALS AND METHODS

This is a case control study on forty diabetic patients who have no symptom or clinical finding of a cardiac problem &have normal LVEF, 22 males (55%), 18 females (45%) and 30 healthy control, so the total member was 70 during the period from 15 September 2019 to 15 January 2020. Patient &control consent as well to ethical approval was taken the Scientific Health Directorate Committee.

INCLUSION CRITERIA

Patients with DM type 1 & type 2 they are on treatment for DM, have no symptom of CVS disease, neither hospitalized nor told to have CVD, have normal CV examination & Have normal LVEF

EXCLUSION CRITERIA INCLUDE

Hypertension is chemic heart disease, heart failure, stroke, valvular heart disease, congenital heart disease & renal failure.

Parameters studied including patients & control age, gender, height, weight, body mass index. Physical examination done also basic biochemical (B. urea, s creatinine, HbA1c, lipid profile), blood picture & resting ECG.

THE ECHO STUDY

- The machine used for the study is GE VIVID E 9; the left ventricle function is studied by M-Mode, 2-D, tissue Doppler & the GLS assessment by speckle tracking technique
- The LVEF is measured by both M-Mode and 2-D by Simpson method but we depend on the latter result in the study.
- The study includes tissue Doppler imaging (TDI), looked to the E prime, A - prime and S wave to get an idea about the annular Longitudinal LV function

To measure the GLS the machine gain settings is optimized to have ideal depth to view the full ventricle, the frame set to 50. A gray scale image for four chambers, 2&3chamber view is taken in three cardiac cycles; we use the three chamber view because the timing of closure of the aortic valve is easily detected. The ECG is connected, three cardiac cycles are acquired &we use the middle one with full visualization of the left ventricle.

The study done with the patient hold breath to avoid any breathing artifacts

For systolic myocardial function assessment, we use peak systolic strain (it reflects systolic shortening fraction) and peak systolic SR, for timing of contraction the time to peak systolic strain and SR have been used by defining the time of aortic valve closure. We use global reference values (mean ± SEM) for the longitudinal peak systolic strain (GLPSS: 18.6 ± 0.1%), although some references use -20% other use 18.0% yet there is no full consensus. Statistical analysis was performed with the statistical package for social sciences (SPSS) version 24, IBM, US.

RESULTS

The result of this case control study where assigned 40 diabetic patients 22 male (55%) & 18 females (45%) who have no cardiovascular symptom, or ECG changes, their LVEF &Doppler studies are within normal, really we found that they have unrecognized systolic dysfunction when we measure their GLS by speckle tracking. In the speckle tracking study, the GLS index shows a significant difference between the diabetic patients and the control group where the mean GLS of the patients was -17.43±3.016, while that for the control group -20.58 ± 1.729, (the normal value of GLS was -18.6). In diabetic patients (25/40) 62.5% have a low reading of GLS in comparison with the control group (3/30) 10% have low GLS. With A P-value=0.012 as shown in table (I).

GLS & LVEF

In spite the fact that all the diabetic patients in this study have normal LVEF with a mean value of 63% yet the comparison between GLS and LVEF of diabetic patients there was a significant correlation between them. The lower normal LVEF the lower GLS where we took LVEF of 63% as it is mean of our patient LVEF value. From 21 patients with EF ≥ 63% only 9(42.8%) have low GLS while 16 out of 19 (82.2%) of a patient with EF less than 63% have low GLS (P value =0.007) as seen in the figure (1).

GLS & S'VELOCITY

In diabetic patients, there is no significant correlation between GLS and S' velocity. Where 17 patients with S' velocity > 0.1, (65%) of them have low GLS and 23 patients with S' velocity ≤ 0.1, (60%) of them have abnormal GLS. P-value=0.804. The other finding in this study is significant correlation between the duration of DM &the degree of systolic dysfunction as reflected by the value of GLS, where the longer the duration of DM the less GLS. Out of 24 diabetic patients with duration over 10 years, 21 of them have low GLS i.e. 87.5%, while 16 patients with diabetic duration less than 10years only 4 have low GLS i.e. 25% with a highly significant statistical value. P-value = 0.0001 as seen in figure (2)

DISCUSSION

In this case control study of 40 diabetic patients&30 normal person as control with no symptom or finding suggestive of heart failure & their LVEF is normal We found that both they have subclinical systolic dysfunction when they are examined using GLS of speckle tracking technique but the GLS drop is more prevalent in diabetic patients compares to the control group. Also the degree of drop of GLS is more in diabetic patient. Which is of statistical significant value (P value=0.012). Traditionally The LV systolic function assessment depends on the measurement of the LVEF by M-mode or Simpson method but this method carry limitation because of the geometric contraction of the LV several studies demonstrated that measurement of LV systolic function by GLS have advantages over LVEF measurement& LV GLS is more sensitive than LVEF to detect subtle changes in LV systolic function whether in normal or some structural cardiac changes [13]. That is what we found that GLS&LVEF may be not parallel in the diabetic & the control group but its drop is more evident in diabetic patients this can be explained on the basic path physiological change which occur in the heart of diabetic patients, which was mentioned above &these may predate the appearance of cardiac symptoms or even to be detected by measurement of LVEF. The other finding in this study is the effect of duration of DM on the deterioration of systolic function which can be explained logically that the above path physiological changes progress with the duration of DM even that it does not give symptom of systolic dysfunction or discovered by abnormality in LVEF. These

results aligned with similar studies of Gehan Magdy, Yehia Ghanem et al. [14] & Hiromi Nakai, Masaaki Takeuchi et al. [15] who studied the correlation between the effects of DM duration on systolic function where they found a negative correlation between peak systolic longitudinal strains with the duration of DM. Even within the sample of diabetic patients with normal LVEF there is a correlation between the value of LVEF & the GLS where those who have lower normal LVEF having lower GLS value, also can be explained by the progression of the myocardial path physiological changes or silent vascular causes. Most of the diabetic patient in this study is poorly controlled with high HbA1c so its correlation to the GLS is not considered

CONCLUSIONS

The recognition of subclinical systolic dysfunction in asymptomatic diabetic patients when they are examined by Speckle tracking technique using GLS as a parameter guide us that the early asymptomatic cardiac structural changes hide a functional systolic dysfunction which may alert us for early recognition &implant strategy for intervention.

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ORCID and contributionship:

Ali Hassan: 0000-0001-7301-5244 [A-F]

Karim O. Al Naffi: 0000-0001-7218-2163 [A-F]

Conflict of interest:

The Authors declare no conflict of interest.

CORRESPONDING AUTHOR

Karim O. Al Naffi

Al Hussain Medical City

Karbala, Iraq

e-mail: karimalnaffi@yahoo.com

Received: 09.07.2021

Accepted: 26.11.2021

A - Work concept and design, **B** – Data collection and analysis, **C** – Responsibility for statistical analysis, **D** – Writing the article, **E** – Critical review, **F** – Final approval of the article