Impact of Phase Analysis of Gated SPECT to Assessment of Left Ventricular Mechanical Dyssynchrony in Diabetic Patients with Normal MPI

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Abstract

Objective: Diabetes mellitus is an important cause of heart failure deployment of left ventricular mechanical dyssynchrony. Nuclear cardiology phase analysis is an accurate, repeatable and reproducible modality for measurement LV dyssynchrony .The aim of study was assessment of phase analysis parameter including Standard deviation (SD) and band width (BW) in diabetic patient with normal MPI comparing with low risk population for CHD.

Materials and Methods: An analytical cross-sectional study was performed in clinical research development unit of Farshchian heart center, Hamedan University of Medical Sciences. We evaluated 165 patients who underwent SPECT MPI. Study population were 90 diabetic patients with normal MPI (sss<3) and 75 health individuals without diabetes. Phase analysis parameters were compared in both groups using Quantitative Gated SPECT (QGS) software. Independent sample t-test and Pearson correlation test were used to compare the results.

Results: The study results revealed no statistically significant differences in standard deviation (SD) and histogram band width (BW) of the phase analysis between diabetic patients and control group. Furthermore, in diabetic patient LVEF have a negative significant correlation to BW (r=-0.510) and SD (r=-0.422) but in control group there was no significant Pearson correlation is noticed.

Conclusion: Between diabetic patients and low likelihood person for CHD with normal MPI phase analysis parameter (BW and SD) shows no significant difference.

Keywords: Diabetes mellitus, Phase analysis of gated SPECT, Left ventricular mechanical dyssynchrony

Introduction

Cardiovascular disease is one of the main causes of mortality and morbidity in diabetic patients.(1) Diabetes mellitus is an important cause of heart failure.(2) Reorganization of left ventricular mechanical dyssynchrony before evidence of clinical heart failure may be helpful in prognosis of diabetic patient. Several studies results show advantage of cardiac resynchronization therapy in heart failure management.(3-5) Left ventricular (LV) dysfunction could decrease cardiac output and volumes (6,7)

Gated Single Photon Emission Computed Tomography (SPECT) is a non-invasive modality for assessment of myocardial ischemia. (8)Gated SPECT provide an accurate evaluation of global LV function and volumes. (9) Phase analysis is an unique method for evaluation of synchrony regional cardiac contraction. (10)

Phase analysis using gated myocardial perfusion imaging (MPI) demonstrated the

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time of myocardial tissue contraction. (11) Nuclear cardiology phase analysis is an accurate, repeatable and reproducible modality for measurement LV dyssynchrony. (12) Histogram of width and phase standard deviation are two main parameters for assessment of LV dyssynchrony. (13) The aim of study was assessment of phase analysis parameters in diabetic patients with normal MPI comparing with low risk (risk of CHD <5%) population for coronary heart disease (CHD) and normal MPI.

Materials and Methods

This cross-sectional study was performed among 2016 t0 2017 in clinical research development unit of Farshchian heart center, Hamedan University of medical sciences .We divided 165 patients in to two groups. Diabetic patients group including documented diabetes mellitus more than one year, no fixed or reversible perfusion defect in myocardial perfusion scintigraphy and no evidence of high risk MPI marker including transient ventricular dilation (TID), increased lung heart ratio (LHR), transient right ventricular (RV) visualization.

The normal group was individuals with normal Fasting blood glucose and Normal gated SPECT study including low likelihood probability for coronary artery disease, no CHD risk factor, no fixed or reversible defect in MPI, normal gated study and no high risk marker in MPI. Exclusion criteria were History of document CHD, percutaneous intervention or coronary arteries bypass grafting (CABG). Cardiac arrhythmia with delayed conduction including LBBB, right BBB or intra-ventricular conduction delayed, patient with pace marker, patient with evidence of heart failure or valular disease.

Gated SPECT protocol

Radio pharmaceutical: TC-995m MIBI (methy-isbutyl-ionitrit), two day stress and rest protocol. Type of stress: exercise or pharmacologic stress test with dipyridamole. Gamma camera: Collimator: high resolution. Matrix: 64*64 with 32 projections. Aqusion time: stress=30s rest=30s. ECG gated was performed in stress phase only with 8 frames R-R interval and 20% acceptance window. Software processing: QPS/QGS cedar Sinai.

Statistical analysis: SPSS statistical software (SPSS version 17.0) was used for statistical analysis. A p-value of less than 0.05 was considered statistically significant. Independent T-test and Pearson correlation were done.

Results

Table 1 revealed the baseline characteristic of two studied groups. There were 90 (30 (33.4%) male and 60 (66.6%) female) patient in diabetic group and 75 (30 (40%) male and 45(60%) female) in non-diabetic group (*P*-value:0.41). There was no statistically significant difference between phase histogram band width (BW) and standard deviation (SD) in two studied groups. Regarding the optimize cut off valve for BW and SD, no evidence of LV dyssynchrony was noticed. Correlation between LVEF and phase analysis parameter using Pearson correlation in both case and control group revealed in table 2. In diabetic patient LVEF have a

Table 1. The baseline characteristic of two studied groups

Variable	Diabetes group (Mean ± SD)	Non-diabetic group (Mean ± SD)	*P*-value
Age	60.3 ± 8.9	58 ± 11.1	0.19
BMI[1]	27.5 ± 5.3	22.3 ± 2.1	0.001
ESV[2]	21.2 ± 11	19.5 ± 8	0.288
EDV[3]	65.1 ± 15	62.7 ± 12	0.267
EF[a]	69 ± 5	69 ± 10	0.308
BW[b]	22 ± 8.6	21 ± 7.1	0.736
SD[c]	5.4 ± 2.7	4.9 ± 2.5	0.306

1- Body Mass Index, 2- End Systolic Volume, 3- End Diastolic Volume, a- Ejection/Fraction, b- Band width, c- Standard deviation

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negative significant correlation with BW and SD but in control group there was no significant difference.

Discussion

The main result of our study showed no dyssynchrony in two studied groups without statically significant difference. Although the study results showed no differences between two groups, but presence of significant negative Pearson correlation coefficient between BW and SD with EF should be noted. Diabetes mellitus is a global health problem and is a major risk factor for cardio-cerebral vascular damages. Phase Analysis of Gated SPECT is helpful for selection patients with heart failure who are candidate for Cardiac Resynchronization Therapy (CRT) devices. (4) Harmonic contraction is necessary for good LV function (14). LV dyssynchrony is considered as a predictor of heart failure. (14)

Echocardiography, cardiac MRI and gated MPI could be used for evaluation of LV dyssynchrony. (10,15-17) Echocardiography may be considered as operator dependent modality. (18) Cardiac MRI is an expensive modality with long time study duration. Phase analysis with gated SPECT MPI is available, non-expensive, accurate, repeatable and reproducible modality for measurement LV dyssynchrony. (12)

Good correlation between real time 3d echocardiography with GMSMPI is suggested (18,19). Reported that LV systolic function is matched with Phase analysis parameters .(20)

Identification of patients with LV dyssynchrony and normal LV ejection fraction may be found patients in the sub clinical stage of heart failure. Timely detection and treatment at early stage is very important to prevention and improvement of left ventricular dysfunction.

Table 2. Correlation between LVEF and phase analysis parameter

Variable	BW	SD
Diabetic group	-0.510	-0.422
LVEF	*P*-value: 0.001	*P*-value: 0.001
Control group	-0.194	-0.066
LVEF	*P*-value: 0.095	*P*-value: 0.5

Reveal phase analysis parameters (SD and BW) are increased in patient with hypertension comparing with control group.(19) But in our study Statistic significance was not seen in mean SD and BW in diabetic patients comparison to normal group. Comparison with case group and non-diabetic group with low likelihood probability for CAD the negative significant correlation between EF and phase analysis parameter (BW and SD) is detected which may be suggestive of a subclinical between above mentioned parameter.

Phase analysis gated SPECT MPI is an advantageous method in diagnosis of LVD. (19) If similar study perform with a large sample size may demonstrate a new finding. Also the diagnostic research including all of phases of diagnostic studies is essentially to determine the diagnostic and prognostic value of phase analysis using Gated SPECT MPI.

Conclusions

The main result of our study showed no dyssynchrony in two studied groups without statically significant difference. Although the study results showed no differences between two groups, but presence of significant negative Pearson correlation coefficient between BW and SD with EF should be noted. Diabetes mellitus is a global health problem and is a major risk factor for cardio-cerebral vascular damages. Phase Analysis of Gated SPECT is helpful for selection patients with heart failure who are candidate for CRT devices.

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