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RELATION OF HIGH SENSITIVE CARDIAC TROPONIN TO LEFT VENTRICULAR DEFORMATION IN PATIENTS WITH IDIOPATHIC DILATED CARDIOMYOPATHY

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Objectives

The aim of this study was to evaluate the left ventricular function in patients with idiopathic dilated cardiomyopathy (IDCM) by myocardial deformation imaging and detect its relation to the level of high sensitive cardiac troponin hs-(cTnT) in these patients.

Background

Myocardial mechanics of the left and right ventricles were recently used to evaluate global and regional myocardial function in different cardiac disease and would be especially useful in assessing idiopathic dilated cardiomyopathy (IDCM) patients.

Patients and methods

32 patients where included in our study from patients diagnosed with (IDCM) who were referred to (Yacoub research unit, Menoufia university hospital, Egypt) between 2016 and 2020 for management, follow up or family screening compared to 25 healthy individuals. Off‑line 2D strain analysis was performed by echocardiography for the assessment of strain and Strain Rate (SR) of the left and right ventricles. Also by using the Elecsys Troponin T High- Sensitive Immunoassay, serum hs-cTnT was measured.

Results

At the end of our study significant changes of myocardial mechanics of the left ventricle were observed with significant reduction in the left ventricular global peak systolic strain % (εsys %) (-6.06 ± 3.87), left ventricular global systolic strain rate (SR sys) (-0.49 ± 0.54), left ventricular global early diastolic strain rate (SRe dia) (0.43 ± 0.33) and left ventricular global atrial diastolic strain rate (SRa dia) (0.30 ± 0.16) of

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IDCM group compared to control group and they were significantly correlated with cardiac troponin T levels measured with highly sensitive assays also the myocardial mechanics are more significantly affected in patients with higher levels of hs-cTnT

Conclusion

In conclusion, from our results there were significant correlation between LV deformation parameters and hs-cTnT levels and suggests that we can use the myocardial mechanics for risk stratification of patients with IDCM.

Keywords: deformation imaging, dilated cardiomyopathy, high sensitive troponin.

Introduction

A primary cardiac disease of uncertain aetiology, idiopathic dilated cardiomyopathy (IDCM) is represented by ventricular enlargement and decreased myocardial contractility [**1**]. Heart failure is the primary clinical sign of IDCM, which is frequently accompanied by arrhythmia and unexpected death. An accurate assessment of the patient's myocardial function is crucial for the diagnosis, evaluation of the therapeutic impact, and prognosis [**2**].

Traditionally, volume-based evaluation of ejection fraction (EF), evaluation of regional wall motion, or visual estimation of regional thickening have been the most common methods available for using echocardiography to evaluate contractile function. These techniques have suffered from a lack of standardization and consistency, and they are typically regarded as being incredibly sensitive to loading circumstances. Due to these disadvantages, there is interest in methods that enable more accurate and consistent measurements of contractile function [**3**].

By measuring regional myocardial strain and strain rate, myocardial deformation imaging, a novel echocardiographic technique for evaluating global and regional myocardial function, enables more detailed evaluation of myocardial muscle shortening and lengthening all across the cardiac cycle. [**4**].

Cardiac troponin T (TnT) serum levels can be measured as an easy-to-use indicator of myocyte damage. We recently discovered that TnT is a prognostic marker in individuals with idiopathic and secondary DCM whose prognosis is poor and who have abnormally high serum concentrations of TnT without an increase in serum creatine kinase (CK) concentrations [**5**].

However, the limited sensitivity of the assay technique, places restrictions on the clinical application of the serum levels of cTnT. In fact, as stated in the most recent guideline for biomarker evaluation, dependable precision (the coefficient of variation (CV) at the 99th percentile upper reference limit for test should be established as 10%) enables for even more sensitive assays [**6**].

Recently, high sensitive cardiac troponin (hs-cTnT) became available and has proven to be an effective prognostic marker in CHF patients with IDCM [**7**].

This study aimed to assess left ventricular function using myocardial deformation imagining and detect its relation to hs-cTnT level in patients with IDCM.

Patients and methods

This was a single‑center prospective study, 32 patients where included from patients diagnosed with idiopathic dilated cardiomyopathy (IDCM) who were referred to

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(Yacoub research unit, Menoufia university hospital, Egypt) between 2016 and 2020 for management, follow up or family screening compared to 25 healthy individuals. All the patients included signed the informed consent and approvals of Ethics Committee of Menoufia University Hospitals and were underwent to history taking, clinical examination, Electrocardiogram (ECG), echocardiogram, and coronary angiography

Exclusion criteria: The patients excluded who had any of the following diseases: Ischemic heart disease, severe valvular disease, other causes of cardiomyopathy (hypertrophic/restrictive), pericardial disease, congenital heart disease and decompensated heart failure (who are usually orthopneic with difficulty to get adequate conventional echocardiographic and deformation imaging study), also emphysema or chest disease which prevent good quality echocardiographic study.

Conventional echocardiogram study: Standard echocardiographic examination was performed to all patients using Esaote Mylab Gold 30 ultrasound system (Esaote S.p.A, Florence, Italy) equipped with a multi-frequency 2.5–3.5 MHz phased-array transducer. The standard transducer positions were used to get the following views: parasternal long axis, parasternal short-axis, apical 4 chambers & apical 2 chambers. And from these views the left atrial (LA) diameter and volume, Left ventricular (LV) dimensions including end diastolic & end systolic dimensions (EDD), (ESD), septum thickness (ST), posterior wall thickness (PWT), ejection fraction (EF %) and LV mass index (LVMI) were measured and the body surface area (BSA) was used to get the measured related to BSA. All these measures were taken in correspondence with the American Society of Echocardiography's recommendations [**8**]. Color flow mapping were used to grade severity of mitral regurgitation (MR) and tricuspid regurgitation (TR) according to the jet area method [**9**] and also used continuous wave Doppler to estimate pulmonary arterial pressure (PAP) from TR velocity. Systolic PAP was calculated from the TR jet velocity (V) using the Bernoulli equation [**10**]. Doppler at mitral leaflets tip was used to obtain peak early (E), late (A) transmitral filling velocities, the ratio of E/A velocity and E-wave deceleration time (DT) then the tissue doppler imaging was used to measure mitral annular early diastolic (E'), atrial diastolic (A') velocities. The ratio of E/E' was calculated by using average E'[**11**].

Deformation imaging: During 3 cardiac cycles, utilizing the XStrainTM software, an excellent quality ECG signals with a frame rate (70 ± 20 F/s) that was modified based on the heart rate was stored for off-line analysis. Using digitized 2D video clips, vector velocity imaging (VVI) is a specialized program that calculates longitudinal myocardial velocity, strain, strain rate, and displacement. A point-and-click method is used to automatically draw the endocardial border at the end of diastole [**12**].

Myocardial mechanics of the left ventricle: Border tracking of the left ventricle (LV) was traced in the recorded clips of apical 4 chamber and 2 chamber views. [**12**]. Longitudinal strains(εsys) and strain rate (SR) during systole (SRsys), early (SRe) and late diastole (SRa) in the basal, mid and apical segments of septal, lateral, anterior and inferior wall were measured. By averaging all previously collected data LV Global ε sys, SR sys, SRe dia and SRa dia were obtained. For evaluation of LV mechanical dys-synchrony, time to peak strain (TTP) was calculated as the interval between the

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commencement of the Q wave of the ECG and the maximal systolic strain for each ventricular segment. And from apical views the twelve LV myocardial segments were acquired, and the difference in time to peak systolic strain (d-TTP) was used to evaluate the intraventricular electromechanical delay [**13,14**]. The standard deviation of the averaged time-to-peak-strain was used to characterize and define LV Mechanical dyssynchrony (TTP-SD) [**12**].

Myocardial mechanics of the right ventricle (RV): The RV was tracked from the septal side of the tricuspid annulus to RV free wall side. Longitudinal εsys, SRsys, SRe, SRa in the basal, mid and apical segments of RVFW and septum were measured. By averaging all previously collected data RV Global ε sys, SR sys, SRe dia and SRa dia were obtained. [**15**].

Measurement of high sensitive cardiac troponin: In a clinically stable setting which is the same sitting of echocardiography study, peripheral venous blood samples were taken for the evaluation of the biomarker. Plasma was separated by centrifugation and by using the Elecsys Troponin T High- Sensitive Immunoassay (Roche Diagnostics Ltd., Rotkreuz, Switzerland), serum hs-cTnT was measured.

Statistical analysis: Values were presented as numbers and proportions for qualitative variables or median and range for quantitative variables. Quantitative variables were checked for normality by Shapiro-Wilk test. Groups were compared by Mann-Whitney test. The correlation between hs-cTnT level and cardiac phenotypes and function outcomes were correlated by Spearman's rank correlation coefficient. hs-cTnT in the DCM group was categorized into high and low based on the median value 8 considered as a cutoff. Variables with P values <0.05 showing significant correlation with hs-cTnT were introduced in a logistic model to detect independent predictors of elevated hs-cTnT level. ROC curve analysis was conducted to assess the sensitivity and specificity of the significant predictors in detecting elevated hs-cTnT level. All tests were bilateral and a P value of 5% is the limit of statistical significance. Analysis was performed by statistical package software IBM- SPSS version 24.

Results

32 patients where included aged 39 ± 20 years (56.3% male patients), compared to 25 healthy individuals as control group aged 24 ± 17 years (56% male patients). 31 IDCM patients were symptomatic 96.9% of the IDCM group.

There were no differences between the idiopathic dilated cardiomyopathy (IDCM) and control groups in systolic or diastolic blood pressure (P = 0.172). Age (P = 0.007) and heart rate (P = 0.016) in the IDCM group were significantly higher than that in the control group.

Table 1 Conventional echocardiographic measurements

Variable	IDCM (n=32)	Control (n=25)	P value
ESD (mm)	52.3 ± 12.64	28.9 ± 5.40	0.000*
EDD (mm)	62.2 ± 13.43	45.6 ± 8.21	0.000*
EF %	35.25 ± 12.65	65.7 ± 6.53	0.000*
LA volume (ml)	59.4 ± 37.20	23.4 ± 11.51	0.000*

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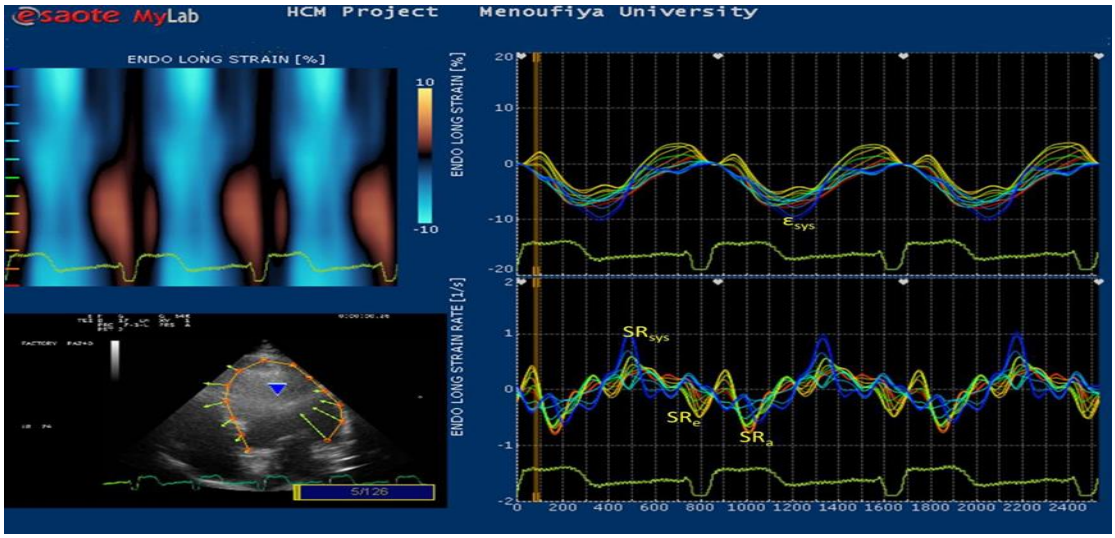
LA volume (ml/m2)	34.6 ± 21.81	15.5 ± 5.45	0.000*
LVMI	194.5± 67.6	102.3±31.67	0.000*
E/E'	12.1 ± 5.50	4.8 ± 0.61	0.000*
PAP	29.9 ± 10.30	18.4 ± 2.80	0.000*
TR severity:			
0 No	6 (18.75%)	19(76%)	
1 Trivial	16 (50%)	6 (24%)	0.000*
2 Mild	10 (31.25%)	0 (0%)	
MR severity:			
0 No	0 (0%)	15 (60%)	
1 Trivial	13 (40.6%)	10 (40%)	
2 Mild	7 (21.9%)	0 (0%)	0.000*
3 Moderate	8 (25%)	0 (0%)	
4 Severe	4 (12.5%)	0 (0%)	

*, statistically significant; ESD, left ventricular end systolic diameter; EDD, end diastolic diameter; EF, ejection fraction; LA, left atrium; LVMI, left ventricular mass index; E, early mitral inflow; E', mitral annulus early diastolic velocity; PAP, pulmonary arterial pressure; TR, tricuspid regurgitation; MR, mitral regurgitation.

Conventional echocardiography data: The left ventricular internal end systolic & end diastolic dimensions (ESD & ESD), left atrial LA volume, left ventricular mass index (LVMI), early (E) transmitral filling velocity / mitral annular early (E') diastolic velocity (E/E'), pulmonary arterial pressure (PAP), tricuspid regurgitation (TR) severity and mitral regurgitation (MR) severity are significantly increased in the IDCM group while the ejection fraction % (EF) decreased in the IDCM group compared to the control group ($P < 0.001$) (Table 1).

Myocardial mechanics in studied groups: Significant reduction was observed in the LV global Longitudinal strains (εsys) %, LV global strain rate (SR) during systole (SRsys), early (SRe) and late diastole (SRa) of IDCM group compared to control ($P < 0.001$) Also there was significant increase in the LV standard deviation of time to peak (TTP-SD) of IDCM group compared to control ($P < 0.001$) (Table 2) (Figure 1).

Figure 1



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2D strain imaging , lower left :with vector velocity view , upper left : curved M-mode, upper right: peak systolic longitudinal strain with 12 curves of εsys% derived from the corresponding segments. Lower right: Strain rate SRsys : positive curve; SRe and SRa: negative curves.

Table 2 Myocardial mechanics of the left and right ventricles:

Variable	IDCM (n=32)	Control (n=25)	P value
LV global εsys %	-6.06 ± 3.87	-19.87 ± 2.49	0.000*
LV global SR sys	-0.49 ± 0.54	-1.28 ± 0.21	0.000*
LV global SRe dia	0.43 ± 0.33	1.55 ± 0.30	0.000*
LV global SRa dia	0.30 ± 0.16	0.60 ± 0.098	0.000*
LV TTP-SD	101.2 ± 90.57	29.24 ± 16.81	0.000*
RV global εsys %	-11.36 ± 4.96	-20.22 ± 4.44	0.000*
RV global SRsys	-0.96 ± 0.36	-1.09 ± 0.22	0.000*
RV global SRe	0.73 ± 0.39	1.65 ± 0.63	0.000*
RV global SRa	0.72 ± 0.36	0.57 ± 0.18	0.171
RV TTP-Mean	372.76± 94.09	353.36± 43.69	0.412
RV TTP-SD	84.82 ± 43.12	44.18 ± 26.71	0.000*

*, statistically significant; LV, Left ventricle; RV, Right ventricle; εsys, peak systolic strain; SRsys, systolic strain rate; SRe, early diastolic strain rate; SRa, atrial diastolic strain rate; TTP, time to peak strain; TTP-SD, standard deviation of time to peak.

Regarding to the right ventricular myocardial mechanics significant reduction was observed in the RV global εsys %, RV global SR sys and RV global SRe dia of IDCM group compared to control ($P < 0.001$) Also there was significant increase in the RV TTP-SD of IDCM group compared to control ($P < 0.001$) (Table 2).

hs-cTnT results and its correlations with the Conventional echocardiographic parameters: Significant elevation was observed in the hs-cTnT levels in the IDCM group with mean level 13.815 ± 14.45 pg/ml while in the control group was 3.772 ± 0.17 pg/ml, ($P < 0.001$), and after correlated with the conventional echocardiographic parameters, there were significant correlations between hs-cTnT levels and two parameters only of the conventional echocardiography in the IDCM group which were ESD ($P = 0.001$) and EDD ($P < 0.001$). And there was no significant Correlation between conventional echocardiographic parameters and hs-cTnT levels in the control group apart from MR severity ($P = 0.021$) (Table 3).

Table 3: Correlations between conventional echocardiographic parameters and hs-cTnT levels in the IDCM and control groups

	IDCM group		**Control group**	
	r	p	r	p
ESD	0.541	0.001*	-0.124	0.555
EDD	0.617	0.000*	-0.097	0.644
EF%	-0.109	0.551	-0.019	0.929
E/E'	-0.107	0.561	-0.074	0.727
LVMI	0.339	0.062	-0.104	0.622

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LA volume (ml)	0.347	0.052	-0.120	0.568
LA volume (ml/m2)	0.195	0.292	-0.360	0.077
PAP	0.226	0.213	0.349	0.087
TR severity	0.082	0.660	-0.254	0.221
MR severity	0.037	0.841	0.459	0.021*

r, Correlation Coefficient; P, Significance; *, statistically significant; ESD, left ventricular end systolic diameter; EDD, end diastolic diameter; EF, ejection fraction; LA, left atrium; LVMI, left ventricular mass index; E, early mitral inflow; E', mitral annulus early diastolic velocity; PAP, pulmonary arterial pressure; TR, tricuspid regurgitation; MR, mitral regurgitation.

Correlations between myocardial mechanics and hs-cTnT levels: On the other hand most of the myocardial deformation imaging parameters were significantly correlated to the hs-cTnT levels in the IDCM group including LV global εsys % ($P < 0.001$), LV global SRe dia ($P = 0.002$), LV global SRa dia ($P = 0.018$), LV TTP-SD ($P = 0.016$), RV global SR sys ($P = 0.048$), RV global SRe dia ($P = 0.008$), RV TTP-Mean ($P = 0.028$) and RV TTP-SD ($P = 0.039$) (Table 4). And there was no significant correlation between myocardial deformation imaging parameters and hs-cTnT levels in the control group (Table 4).

Table 4: Correlations between myocardial mechanics and high sensitive cardiac troponin T levels in the IDCM and control groups

	IDCM group		**Control group**	
	r	p	r	p
LV global εsys %	0.716	0.000*	0.015	0.943
LV TTP-SD	0.421	0.016*	-0.125	0.552
LV global SR sys	0.215	0.238	-0.165	0.430
LV global SRe dia	-0.532	0.002*	0.002	0.292
LV global SRa dia	-0.416	0.018*	-0.129	0.540
RV global εsys%	0.323	0.072	0.148	0.482
RV TTP-Mean	0.389	0.028*	0.121	0.563
RV TTP-SD	0.368	0.039*	0.229	0.271
RV global SR sys	0.352	0.048*	0.018	0.931
RV global SRe dia	-0.460	0.008*	-0.128	0.542
RV global SRa dia	-0.090	0.623	-0.007	0.974

r: Correlation Coefficient; P: Significance; *, statistically significant; LV, Left ventricle; RV, Right ventricle; εsys, peak systolic strain; SRsys, systolic strain rate; SRe, early diastolic strain rate; SRa, atrial diastolic strain rate; TTP, time to peak strain; TTP-SD, standard deviation of time to peak.

After that we divided the IDCM group into two groups according to the hs-cTnT levels that was categorized into low and elevated groups based on the value of the median of the hs-cTnT level in the IDCM group which was $7.7 \approx 8$.

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Table 5: Deference between the IDCM group with low hs-cTnT levels and the IDCM group with elevated hs-cTnT levels according to conventional echocardiographic parameters

Variable	Low hs-cTnT (<8) (n=16)	Elevated hs-cTnT (>=8) (n=16)	P value
ESD (mm)	46.07 ± 9.6	58.52 ± 11.83	0.002*
EDD (mm)	54.85 ± 11.05	69.60 ± 10.89	0.001*
EF %	36.06 ± 9.19	34.43 ± 14.98	0.375
LA volume (ml)	44.28 ± 31.1	74.60 ± 35.42	0.101
LA volume (ml/m2)	29.99 ± 14.81	38.94 ± 25.44	0.323
LVMI	164.16 ± 57.70	223.02 ± 61.40	0.017*
E/E'	12.65 ± 5.57	11.58 ± 5.2	0.664
PAP	29.94 ± 10.01	29.93 ± 10.27	0.865
TR severity:			
0 No	2 (12.5%)	4(25%)	
1 Trivial	10 (62.5%)	6 (37.5%)	0.762
2 Mild	4 (25%)	6 (37.5%)	
MR severity:			
0 No	0 (0%)	0 (0%)	
1 Trivial	6 (37.5%)	7 (43.75%)	0.736
2 Mild	5 (31.25%)	2 (12.5%)	
3 Moderate	4 (25%)	4 (25%)	
4 Sever	1 (6.25%)	3 (18.75%)	

*, statistically significant; ESD, left ventricular end systolic diameter; EDD, end diastolic diameter; EF, ejection fraction; LA, left atrium; LVMI, left ventricular mass index; E, early mitral inflow; E', mitral annulus early diastolic velocity; PAP, pulmonary arterial pressure; TR, tricuspid regurgitation; MR, mitral regurgitation.

Table 6: Deference between the IDCM group with low hs-cTnT levels and the IDCM group with elevated hs-cTnT levels according to myocardial mechanics of the left and right ventricles

Variable	Low hs-cTnT (<8) (n=16)	Elevated hs-cTnT (>=8) (n=16)	P value
LV global εsys %	-8.15 ± 4.07	-3.97 ± 1.95	0.001*
LV TTP-SD	102.45±113.48	99.97 ± 54.88	0.136
LV global SR sys	-0.47 ± 0.48	-0.5 ± 0.57	0.611
LV global SRe dia	0.56 ± 0.38	0.29 ± 0.16	0.018*
LV global SRa dia	0.36 ± 0.17	0.23 ± 0.11	0.020*
RV global εsys %	-13.29 ± 4.54	-9.41 ± 4.42	0.030*
RV TTP-Mean	350.12± 60.27	395.39± 111.97	0.054
RV TTP-SD	65.93 ± 26.21	103.70 ± 46.93	0.018*
RV global SR sys	-1.07 ± 0.38	-0.84 ± 0.29	0.057
RV global SRe dia	0.93 ± 0.36	0.52 ± 0.27	0.004*
RV global SRa dia	0.77 ± 0.40	0.66 ± 0.30	0.610

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*, statistically significant; LV, Left ventricle; RV, Right ventricle; εsys, peak systolic strain; SRsys, systolic strain rate; SRe, early diastolic strain rate; SRa, atrial diastolic strain rate; TTP, time to peak strain; TTP-SD, standard deviation of time to peak.

A comparison first done between the IDCM patients group with low hs-cTnT levels and the IDCM patients group with elevated hs-cTnT levels according to conventional echocardiographic parameters. We observed significant difference between the two groups in three parameters which were the LV ESD (P = 0.002) and EDD (P = 0.001) that were significantly dilated in the IDCM patients group with elevated hs-cTnT levels and also LVMI which was significantly higher (P = 0.017) in the same group (Table 5).

The second comparison was done between the two IDCM groups according to myocardial mechanics of the left and right ventricles. Significant difference was observed between the two groups in LV global εsys % (P = 0.001), LV global SRe dia (P = 0.018), LV global SRa dia (P = 0.020), RV global εsys % (P = 0.030), RV global SRe dia (P = 0.004) and RV TTP-SD (P = 0.018) (Table 6).

Discussion

In our study we were observing the myocardial mechanics in patients with idiopathic dilated cardiomyopathy (IDCM) and its correlation with the high sensitive cardiac troponin (hs-cTnT) levels in that patients, and we observed significant reduction in the LV global Longitudinal strains (εsys) %, LV global strain rate (SR) during systole (SRsys), LV global early (SRe) and late diastole (SRa) of IDCM group compared to control group and they were (LV global εsys %, LV global SRe dia and LV global SRa dia) significantly correlated with hs-cTnT levels. Also the myocardial mechanics (LV global εsys %, LV global SRe dia and LV global SRa dia) are more significantly affected in patients with higher levels of hs-cTnT. Cho GY, et al. study showed in chronic heart failure patients we can expect cardiovascular events from the longitudinal global strain [**16**]. On the other hand several studies showed raised cardiac troponin levels in patients with IDCM and poor outcomes with persistent elevation of cardiac troponin [**17,18**]. However other studies showed the correlation of cardiac troponin levels and imaging results in patients with IDCM were less than in patients with hypertrophic cardiomyopathy (HCM) and troponin levels not correlate with ejection fraction but correlate with left ventricular dimensions and volumes [**19**]. So its appeared that the assay sensitivity of cardiac troponin test affect the relationship between cardiac troponin levels and prognosis in DCM patients. For TnT measured with highly sensitive assays all studies use it showed significant correlation and found that its independent predictor of adverse cardiovascular events and can be used as a prognostic predictor in heart failure patients [**20-21**]. Eric Y Yang, et al. used Late gadolinium enhancement on cardiac magnetic resonance (CMR) imaging for detection of myocardial replacement fibrosis and and hs-cTnT levels in patients with IDCM and found there correlation with heart failure outcomes and they can be used as prognostic predictors in heart failure patients with IDCM [**22**]

In our study we observed the correlation between hs-cTnT levels and echocardiography parameters in the IDCM group which is more obvious with myocardial deformation imaging parameters as most of them was significantly

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correlated with hs-cTnT levels which were LV global εsys %, LV global SRe dia, LV global SRa dia, & LV standard deviation of time to peak (TTP-SD). While with conventional echocardiography parameters only two parameters was correlated with hs-cTnT level which were the LV end diastolic and systolic dimensions (ESD & EDD).

According to the definition of DCM the right ventricle also may be dilated and dysfunction [34]. Ankur, et al. evaluate RV function by CMR in patients with IDCM and the study results showed that right ventricular dysfunction in IDCM patients improved their evaluation and risk stratification for morbidity, hospitalization and mortality or cardiac transplantation [**23**].

In our study we observed from the right ventricular myocardial deformation imaging parameters significant reduction in the RV global εsys %, RV global SR sys and RV global SRe dia of IDCM group compared to control group, so myocardial mechanics of the RV may be used as predictors of RV dysfunction which improves the evaluation and risk stratification in patients with IDCM.

Also after we divide the IDCM group into two groups 1st group patients with low hs-cTnT levels and the 2nd group with the higher or elevated hs-cTnT levels we observed significant difference between the two groups in conventional echocardiography parameters which were the LV ESD and EDD that were dilated in the IDCM patients group with elevated hs-cTnT levels also the LV mass index (LVMI) was higher in the same group and regarding to the myocardial deformation imaging parameters of the LV we observed significant difference between the two groups in three parameters which were LV global εsys %, LV global SRe dia and LV global SRa dia that were more reduced in the IDCM patients group with elevated hs-cTnT levels. We observed also significant difference between the two groups in three parameters of the myocardial deformation imaging parameters of the right ventricle which was RV global εsys %, RV global SRe dia and RV TTP-SD.

The comparatively small patient population was a limitation and this is due to short life duration as most of the patients discovered late in the course of the disease after they become moderately to severely symptomatic. Also to find patients with non-ischemic dilated cardiomyopathy who performed coronary angiography, CT Coronary angiography or SPECT to exclude ischemic heart disease is not easy.

Diffusion tensor imaging has been used by researchers to characterize both global and regional myocardial motion or deformation with despite having a high temporal resolution, the angle dependency of Doppler, a high noise‑to‑signal, and the variability between observers are unavoidable limitations [**24**].

The alternative motion estimation method proposed here, on the other hand, is based on 2D feature tracking using vector velocity imaging (VVI) processing, a novel method that tracks speckle patterns (acoustic markers) within serial B-mode sector scans. This method is inherently 2D and independent of both cardiac translation and interrogation angle. [**25**].

As we know we can't depend on ejection fraction alone for assessment of prognosis and risk stratification due to its limitation for assessment and many factors affect its

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accurate measurement. And also presence and severity of a functional MR due to IDCM are independently associated with the prognosis in these patients.

the mitral regurgitation severitiy this appears in our study that shows insignificant correlation between the left ventricular ejection fraction and hs-cTnT levels in the IDCM group.

Cardiac magnetic resonance despite its accuracy, very high standard image and its approval by many studies to be used for the prognosis, risk stratification and how to manage in patients with IDCM [**26**] but its unavailability in many hospitals, its expensive cost, time consuming, may be unfit comfortably within the CMR machine for very obese patients and difficulty of some heart failure patient to lay flat for long time limits its use in such patients.

The use of recent echocardiography technologies like myocardial mechanics for assessment of prognosis in such patients improves the risk stratification for sudden cardiac death in IDCM patients [**27**]. And also the good matching between GLS measured using CMR and speckle tracking echocardiography derived strain approved by many studies [**28-29**]. In addition to its availability in our hospitals compared to cardiac magnetic resonance, its low cost and easy to use with accurate results give it upper priority to be used over cardiac magnetic resonance in such patients. To the best of our knowledge this is one of the first studies to correlates between myocardial mechanics and hs-cTnT and found more affection of myocardial mechanics with increased levels of hs-cTnT so we recommend to use the myocardial mechanics for risk stratification, in patients with IDCM.

Conclusions

In our study we use both myocardial mechanics by echocardiography and serum cardiac troponin T levels measured with highly sensitive assays in patients with idiopathic dilated cardiomyopathy (IDCM) and we found significant correlation between them and the myocardial mechanics are more significantly affected in patients with higher and elevated levels of hs-cTnT so we can use the myocardial mechanics for risk stratification, in patients with IDCM.

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