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Effect of Isolated Coronary Artery Ectasia on Left Ventricular Global Longitudinal Strain

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ABSTRACT

Background: Coronary artery ectasia (CAE), known as a dilatation of coronary segment to at least 150% of the diameter of adjacent healthy segment. Despite the fact that coronary ectasia is under-treated angiographic finding, it has a tremendous impact on patients mortality and morbidity. The hypothesis that isolated CAE is a cause of subtle left ventricle (LV) systolic dysfunction needs intense and thorough research. **Objective:** To assess longitudinal LV functions in patients with isolated coronary ectasia using 2 dimensional (2D) speckle tracking echocardiography. **Patients and Methods:** This study is a case control study conducted on two groups of patients referred to our tertiary centre for elective coronary angiography. The first group included 30 consecutive symptomatic patients proved to have CAE without obstructive coronary artery disease. The second group included 30 patients with normal coronary angiography serving as a control group. Patients with any form of structural heart disease affecting LV systolic functions were excluded, echocardiographic evaluation was held for every patient targeting 2D assessment of systolic and diastolic functions, tissue Doppler measurements and finally offline 2D speckle tracking for assessment of global LV longitudinal strain. **Results:** Males were more dominant in CAE group. Hypertension and dyslipidemia were more prevalent in CAE group unlike diabetes that was more common among control subjects. LV volumes, dimensions, mass index, left atrium (LA) volume index and aortic root diameter were significantly higher among CAE group. Mean global longitudinal strain was significantly lower in CAE group with value of (-16.5%) versus (-19.5%) in control group. **Conclusions:** Global longitudinal strain is significantly reduced in patients with CAE even in the absence of obstructive coronary artery disease denoting subclinical LV systolic dysfunction.

Keywords: Coronary, Ectasia, Speckle tracking, Strain.

INTRODUCTION

Coronary artery ectasia (CAE) is defined as dilatation of arterial segment to at least 1.5 times the diameter of the adjacent healthy segment, involving at least 1/3 of the whole arterial length [(1)]. It is seen in approximately 1.5-5% of patients who underwent coronary angiography with male to female ratio of 3:1 [(2,3)].

20-30% of cases of CAE are considered congenital, 50% were attributed to atherosclerosis, 20% were linked to connective tissue disease as Ehlers-Danlos, Kawasaki, Scleroderma and bacterial infections [(4-6)].

Definite pathophysiology of disease is not well defined, however, many postulations existed, including; endothelial dysfunction, micro-vascular disease, oxidative stress, inflammation, enhanced platelet activity and exaggerated positive vascular remodeling [(7)].

Coronary ectasia is most likely an extreme type of atherosclerotic plaque growth-induced expansive vascular remodeling. The enzymatic degradation of the medial extracellular matrix, which appears to be a fundamental pathologic process, is influenced by a number of variables [(8)].

Alterations in blood flow filling and washout are core features of CAE. They represent the direct outcome of inappropriate coronary dilatation and are linked directly to the severity of CAE [(9)]. Angiographic signs of stagnant flow include delayed antegrade contrast filling, a segmental back flow phenomenon and local stasis of dye [(9, 10)].

The clinical presentations of patients affected by CAE include a variety of manifestations that range from angina and myocardial infarction to sudden cardiac death. Stable angina is the most common presentation, and approximately 20% of symptomatic patients required repeated hospital admission [(11)]. Patients with isolated CAE without obstructive CAD had positive results during myocardial perfusion imaging and treadmill exercise tests. Disturbance of the coronary flow and diseased microvasculature are possible pathophysiological mechanisms for myocardial ischemia in those patients [(12-14)].

Complications such as thrombus formation, distal embolization, and rupture can occur. Coronary artery ectasia may rarely break through into the right atrium, right ventricle, or coronary sinus, creating left-to-right shunts [(15-18)].

The main stay of treatment relies on anti-platelets and anticoagulants with appreciable role of high dose statins [(19, 20)]. Administration of nitrates may provocate anginal pain in patients with CAE and should not be administered [(14)]. In patients with coexisting obstructive CAD with limiting symptoms, despite optimal medical therapy, invasive treatment can be offered as percutaneous coronary interventions.

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Polytetrafluoroethylene (PTFE) covered stents showed success in exclusion of coronary aneurysms [21].

The most extensively used approach for evaluating left ventricular (LV) myocardial functioning is conventional 2D echocardiography. This approach, however, is not sensitive enough in the early stages of myocardial infarction. Quantifying myocardial strain, a dimensionless assessment of deformation represented as a fractional or percentage change from an object's initial dimension, can reveal subclinical alterations in LV function. The assessment of regional and global LV functions using two-dimensional speckle tracking-derived strain is an angle-independent technique [22].

Pulsed-wave tissue Doppler imaging and the myocardial performance index (MPI) have both showed that left ventricular (LV) diastolic function is decreased in individuals with CAE [23].

Two-dimensional STE has been applied to assess LV function in many conditions such as the coronary artery disease and coronary slow-flow phenomenon [24].

Aim of work was to assess longitudinal LV functions in patients with isolated coronary ectasia using 2D speckle tracking echocardiography.

PATIENTS AND METHODS

This study is a case control study. Thirty patients with isolated CAE, detected during coronary angiography in our tertiary centre between August 2019 and August 2020, were included in this study and 30 consecutive patients with normal coronary angiography served as a control group.

The indication of coronary angiography was either typical angina or positive results of stress tests. We excluded any patient with previous history of acute coronary syndrome, patients with rhythm other than sinus rhythm, pacemaker implantation, bundle branch block, heart failure and significant valvular disease.

Methodology:

Full history was taken with emphasis on risk factors of myocardial ischemia as smoking, hypertension, dyslipidemia and diabetes mellitus (DM). Routine pre-procedural ECG, laboratory and hematology tests were done for all patients.

Coronary angiography:

Selective coronary angiogram was conducted either through the right femoral artery or right radial artery approach with manual contrast injection in different projections without any intravenous or intracoronary medications.

During coronary angiography, at least five views of the left coronary system (LAO 40/Cranial 20, LAO 40/Caudal 20, RAO 20/Caudal 20, RAO 10/Cranial 40, AP) and two of the right coronary system (LAO 40/Cranial 20, RAO 30/Cranial 20) were recorded 30 frames per second.

CAE was defined as coronary dilation >1.5 times the size of an adjacent normal arterial segment and involves at least one third of the affected artery[1]. The number of the affected arteries was reported. The length and diameter of the ectatic segment were precisely recorded by quantitative coronary analysis (QCA) using Philips Allura Clarity (Best, The Netherlands). Coronary angiographies were reviewed by 2 expert cardiologists who were blinded about patient clinical data.

Echocardiography:

Conventional echocardiographic Doppler study, tissue Doppler imaging, and 2D speckle tracking imaging were performed using Vivid 9 (General Electric Healthcare), equipped with harmonic M4S variable frequency phased-array transducer and echo Pac software for offline analysis.

Images were acquired with patients in the left lateral position at end-expiration according to the recommendations of the American Society of Echocardiography [25] and connected to single-lead electrocardiography (ECG).

Standard images obtained in the parasternal (long and short axis views) and apical (Two, three and four chamber views) echocardiography studies were done by single expert cardiologist who was blinded about patient's clinical and angiographic data.

Quantification of the LV dimensions was done using M-mode echocardiography, and then using the biplane (modified Simpson method). LV mass index was calculated by Devereux formula [26].

Assessment of ventricular regional wall motion abnormalities was done using a 17-segment model. Segmental wall motion was judged by an experienced cardiologist as normal 1; hypokinetic 2; akinetic 3; and dyskinetic 4. Wall motion score index (WMSI) represented the average value of analyzed segments.

LA size and volume were measured from apical window and indexed to body surface area. Aortic root diameter and ascending aorta were measured from parasternal long axis view.

Mitral inflow velocity was recorded from the apical 4-chamber view by pulsed-wave Doppler. Peak early (E), late (A) mitral inflow velocity, E/A ratio were calculated.

Regarding tissue Doppler echocardiography, the sample was set in the apical 4 chamber view at the lateral and medial mitral annuli to record the myocardial motion velocity by the pulsed-wave tissue Doppler and the peak velocity was recorded in at least three cardiac cycles and the mean values of S and E' were calculated.

2-dimensional speckle tracking echocardiography:

With high-quality ECG-gated pictures from the apical four-chamber, two-chamber, and three-chamber perspectives, longitudinal strain imaging by 2D-speckle tracking echocardiography (2D-STE) was performed at almost equal heart rates. The gain settings were tweaked to perfection. The depth was decreased to the point that the LV took up the majority of the picture sector.

To minimise foreshortening of the LV, the gray-scale frame rate was set between 50 and 90 frames/s, and each loop received at least three cardiac cycles. To eliminate breathing artefacts, all of the photographs were taken while holding your breath.

All images were stored in cine-loop format, and data were transferred to a workstation for further offline analysis using the Echo Pac software (General Electric version 1.8.1.X-Vingmed).

Image analysis: In the end-systolic frame, endocardial border was traced manually in the three apical views. Then, the software generated a region of interest (ROI) to include the entire myocardial thickness. The width of the ROI was manually adjusted as required.

The ROI was carefully selected to exclude bright, echogenic pericardium. The programme then created moving pictures that displayed the tracking by tracking the cardiac speckles frame by frame. The operator was able to assess the accuracy of the tracking by looking at the moving picture. When the tracking was inaccurate, the operator went back and readjusted the ROI, or a new ROI was chosen.

In each image, the programme separated the LV myocardium into six segments, generating segmental and global longitudinal strains (GLS). The longitudinal strain was represented below the baseline because the myocardium normally shortens in a longitudinal manner during systole. Peak systolic longitudinal strain for each of the cardiac segments was calculated from these graphs.

To produce the GLS, the strain values for all segments were recorded and averaged, as well as a Bull's eye representation of the regional longitudinal strain and GLS, as shown in figure (1).

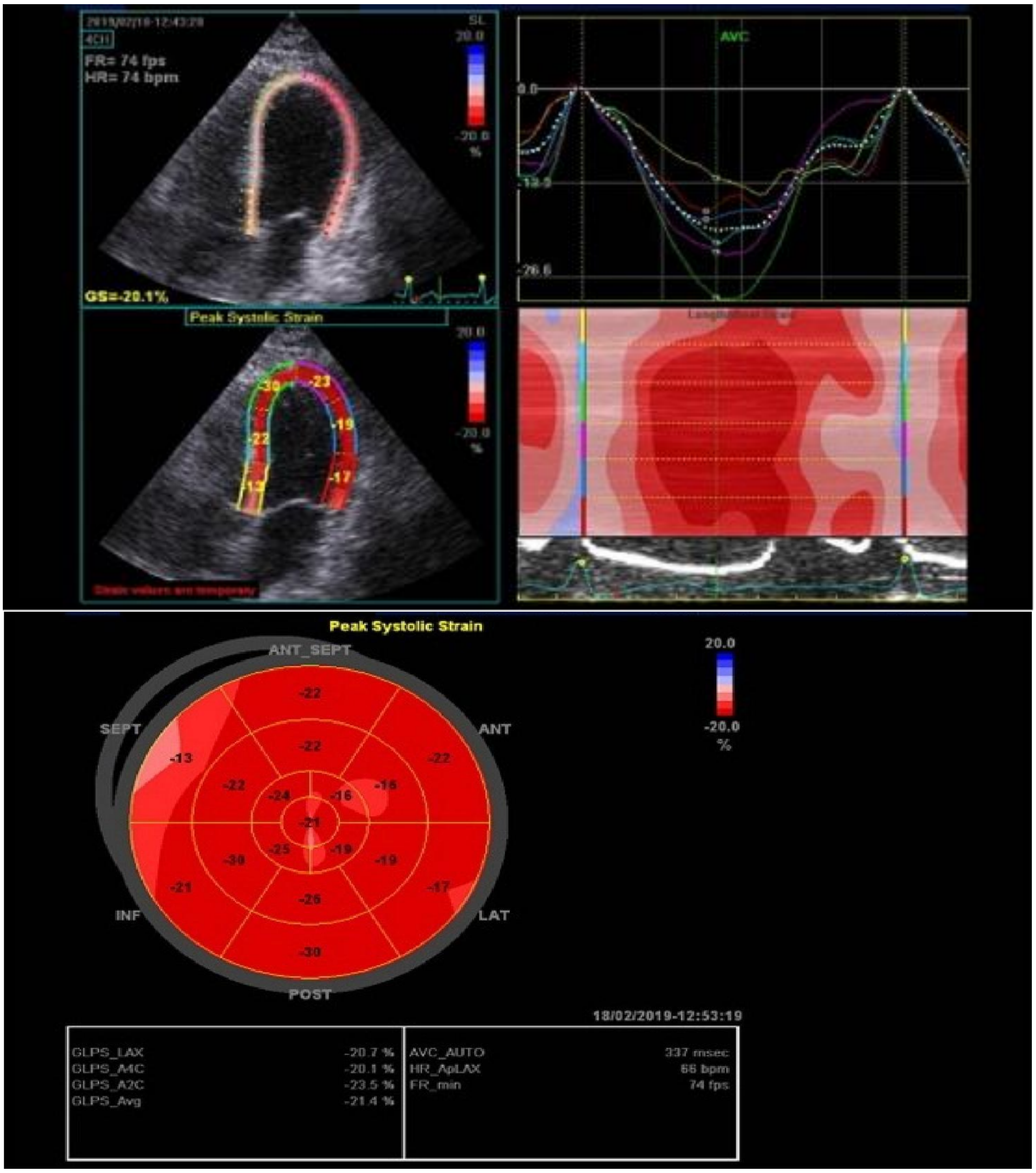

Figure (1): (A) longitudinal strain from apical 4C (-20.1%) (B) Bull eye map of CAE patient with GLS (-21.4%)

Ethical approval and consent to participate:

The Research Ethics Committee of the Faculty of Medicine, Ain Shams University has reviewed and approved the study from the ethical point (FMASU M S 68/2019).The Faculty of Medicine Ain Shams University Research Ethics Committee (REC) is organized and operated according to guidelines of the International Council of Harmonization (ICH) and the Islamic Organization of Medical Science (IOMS), the United Stated Office of Human Research Protection and United States Code of Federal Regulations and operates under federal wide assurance No. FWA 000017585.

The REC doesn't declare the name of its members according to the University and REC standard operating procedures. The data of patients were presented after informed written consent achievement and the steps of research were explained for them with the protection of privacy and confidentiality. This study was conducted in accordance with the 1964 Declaration of Helsinki and its subsequent amendments.

Statistical analysis

Data were analyzed using SPSS version 21 for Windows and graphics by MS Excel. Categorical data were expressed as frequencies and percentages, while continuous data were expressed as mean ± SD and range or median and interquartile range (IQR). Comparison between categorical variables was done using Chi square or Fisher's exact test as appropriate. Comparison between continuous variables was done using t-test or Mann-Whitney test according to normality of distribution. Cutoff values were selected if area under the curve (AUC) was significantly different from 0.5. P value was considered significant if <0.05.

RESULTS

The study population comprised 60 subjects, including 30 patients having coronary artery ectasia without significant coronary artery lesion (52 ± 9 years, 25 male) 47% (14 patients) had ectatic one vessel and 53% (16 patients) had ectasia in more than one vessel, and 30 age matched controls with normal coronary arteries (52 ± 9 years, 10 male). Clinical and demographic data of patients and controls are listed in table 1.

There was no significant difference between the two studied groups regarding mean age. Gender distribution showed that males were more likely to have CAE, (83.3%) in CAE group versus (33.33%) in the control group. Hypertension and dyslipidemia were more common among CAE patients, unlike diabetes that was surprisingly less common. Smoking and family history of premature coronary artery disease showed no significant difference between both groups.

Table (1): Comparison of the demographic data of the two studied groups

Variable		Control Group	CAE Group	P value
		N = 30	**N =30**	
Age	**Mean± SD**	52.75±9.28	52.1±9.78	0.85
	Range	29 - 69	32 - 72	
Sex	**Females N %**	20 (66.7%)	5 (16.7%)	<0.001
	Males N %	10 (13.3%)	25 (83.3%)	
Hypertension	**N %**	14 (46.7%)	23 (76.7%)	0.017
Dyslipidemia	**N %**	12 (40%)	20 (66.7%)	0.038
Diabetes mellitus	**N %**	15 (50%)	4 (13.3%)	0.002
Smoking	**N %**	7 (23.3%)	14 (46.7%)	0.058
Family History	**N %**	7 (23.3%)	4 (13.3%)	0.317

Conventional echocardiographic parameters are listed in table 2, both groups had preserved LV systolic function, however lower left ventricular ejection fraction (LVEF) was noticed among patients with CAE. LV dimensions, LV volumes, LV mass index and LA volume index were significantly higher in CAE group. Aortic root diameter and ascending aortic diameter were significantly larger in CAE group. It is worth-mentioning that six patients with CAE had resting segmental wall motion abnormalities.

Table (2): Echocardiographic parameters of the two studied groups

Variable		Control Group N = 30	CAE Group N =30	P value
EDD (mm)	**Mean±SD**	51.3±2.81	54.33±4.55	0.003
	Range	47 – 58	47 – 69	
ESD (mm)	**Mean±SD**	32.97±2.62	35.33±5.77	0.045
	Range	29-41	28-53	
IVS (mm)	**Mean±SD**	9.73±0.69	11.57±1.7	0.000
	Range	9-12	9-15	
PWT (mm)	**Mean±SD**	9.93±0.87	11.73±1.48	0.000
	Range	9 – 12	9 – 15	
LVEDV (ml)	**Mean±SD**	75.87±16.74	106.7±31.51	0.03
	Range	49 – 128	49 – 182	
LVEDV index (ml/m^{2}))	**Mean±SD**	39.2±8.3	54.2±17.65	0.02
	Range	27 - 65	26 – 94	
LVESV (ml)	**Median (IQR)**	29 (22-32)	39 (32-48)	0.04
	Range	13 – 57	20 - 74	
LVESV index (ml/m^2)	**Median (IQR)**	15 (12-17)	18.5 (16-22)	0.03
	Range	7 – 29	10 - 34	
LVEF (%)	**Mean±SD**	63.13±4.11	59.33±9.09	0.04
	Range	55 – 70	50 - 65	
LV mass (g)	**Mean±SD**	186.87±28.31	260.47±69.39	0.001
	Range	153 - 264	146-426	
LV mass index (g/m^2)	**Mean±SD**	95.1±12.07	128.1±38.71	0.001
	Range	76 – 124	85 – 235	
LA volume (ml)	**Mean±SD**	47.73±14.1	62.13±17.69	0.001
	Range	26 - 82	36 - 112	
LA volume index (ml/m^2)	**Mean±SD**	24.97±6.83	31.55±10.37	0.005
	Range	14-41	17 - 60	
Aortic root (mm)	**Mean±SD**	29.47±2.3	36.17±3.75	0.001
	Range	26 - 34	30 - 46	
Ascending Aorta (mm)	**Mean±SD**	29.13±2.46	39.97±3.79	0.001
	Range	24 - 35	30 - 45	
WMSI	**Mean±SD**	1±0	1.09±0.26	0.051
	Range	1 – 1	1 – 2	

Using tissue Doppler modalities, no significant differences between the two groups regarding mean S' wave velocity, however, mean E' velocity was significantly lower in CAE group. E/E' ratio was significantly higher among CAE patients as shown in table 3.

Table (3): Tissue Doppler echocardiographic parameters among patients in CAE group and control group

Variable		Control Group N = 30	CAE Group N =30	P value
Mean S' (cm/s)	**Mean±SD**	9.02 ± 1.19	8.22 ± 2.01	**0.066**
	Range	7 -12	5 - 13	
Mean E' (cm/s)	**Mean±SD**	10.82 ± 2.61	8.67 ± 2.29	0.001
	Range	7 – 16	4.5 – 14	
E/E'	**Mean±SD**	6.68 ± 2.24	8.62 ± 2.68	0.004
	Range	3 – 13	5 – 15	

LV diastolic dysfunction was more common in the CAE group as 63.3% (19 patients) of them had different grades of LV diastolic dysfunction as shown in table 4 versus only 36.6% (11 patients) of the control group.

Table (4): Diastolic function parameters among two groups

Variable		Control Group N = 30	CAE Group N :30	P value
Diastolic dysfunction grade	**Normal N (%)**	19 (63.3%)	11 (36.7%)	0.151
	DD grade I N (%)	10 (33.3%)	15 (50.0%)	0.162
	DD grade II N (%)	1 (3.3%)	3 (10.0%)	0.162
	DD grade III N (%)	0 (0.0%)	1 (3.3%)	0.162

2-Dimensional Speckle Tracking Echocardiography:

Global longitudinal strain was significantly lower in patients with CAE (- 16.49%) as compared to group with normal coronary angiogram (- 19.47%) as seen in table 5, denoting subclinical LV dysfunction in patients with coronary ectasia. The absolute GLS values ≤ -15.3% had 63.33% sensitivity and 96.6% specificity for the differentiation of CAE from non-CAE, (Figure 2).

Table (5): The longitudinal strain parameters among patients in CAE group and control group

2D speckle tracking echocardiography		Control Group N = 30	CAE Group N :30	P value
Apical 4C%	Mean±SD	-19.93±2.87	-16.99±4.36	0.003
	Range	-25.7 – -14	-28.5 – -6.6	
Apical 2C%	Mean±SD	-19.93±2.9	-16.38±4.36	0.001
	Range	-26.3 - -15.4	-26 -- -7	
Apical 3C%	Mean±SD	-18.6±2.8	-16.22±3.74	0.007
	Range	-23.8 - -11	-22.6 -- - 8.5	
GLS %	Mean±SD	-19.47±2.44	-16.49±3.92	0.001
	Range	-25 – -14	-26 – -8	

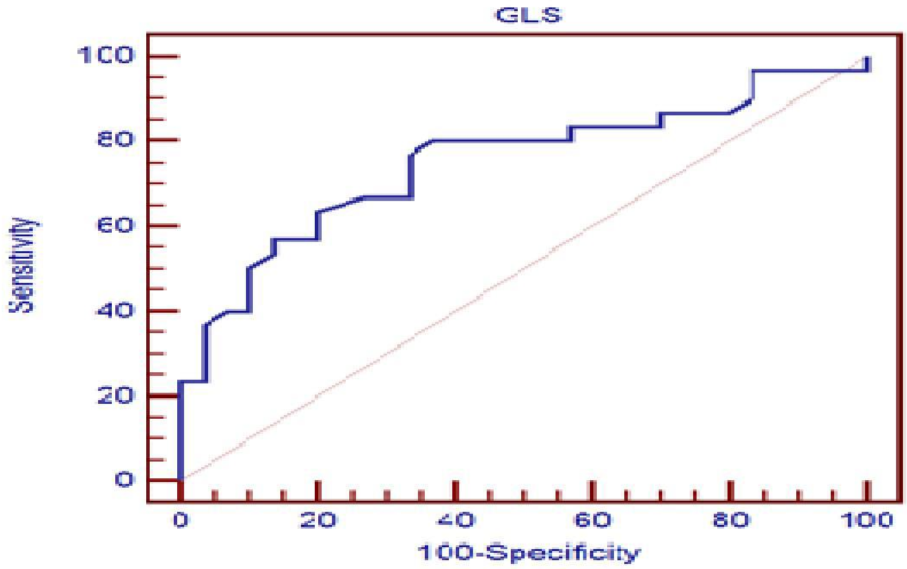

Figure (2): Cut off value of GLS in differentiating CAE from non CAE

Peak GLS correlations:

In the present study, the peak GLS was significantly lower with lower LVEF, lower mean S' velocity and lower mean E' velocity. On the other hand the peak GLS was significantly higher with reduced LV diameters (EDD, ESD) and lower volumes (left ventricular end diastolic volume (LVEDV), LVEDV index, left ventricular end systolic volume (LVESV), LVESV index). The higher peak GLS was the lower LV mass index and WMSI.

DISCUSSION

Coronary artery ectasia is a variant of coronary vasculopathy that should not be underestimated, being diagnosed in approximately 5% of patients undergoing coronary angiography, especially in men [(3)]. It is a common etiology of ischemic chest pain and frequent cause of repeated coronary care unit admissions [(18)]. It is worth-noting that coronary ectasia can predispose to acute thrombotic coronary occlusion precipitating cardiomyopathy [(17)]. But, the confusing issue is whether CAE can cause subtle LV systolic dysfunction in patient with stable angina without significant obstructive coronary artery disease.

Two-dimensional speckle tracking echocardiography is a valuable imaging tool that unleashed new insights into LV mechanics, such as the objective evaluation of global and regional LV function in ischemic and non-ischemic heart, together with the detection of subclinical LV dysfunction in cardiovascular conditions at risk of progression to manifest cardiomyopathy [(24)].

Our study included sixty patients referred to catheterization lab of our centre subdivided into two groups, coronary artery ectasia group that included thirty patients with isolated coronary artery ectasia, 47% (14 patients) had ectatic one vessel and 53% (16 patients) had ectasia in more than one vessel, and control group that included thirty patients with normal coronary arteries serving as control group.

In the current study, males comprised 83.3% of CAE patients and 33.3% of control group. Dyslipidemia and hypertension were heavily represented among CAE patients, unlike DM that was more encountered among the control group. LV systolic functions were preserved in both groups; however, LVEF was numerically lower among patients with isolated CAE. LV internal dimensions, LV mass index, LA volume index, ascending aorta diameter and aortic root dimensions were significantly higher among patients with isolated CAE. All patients in the control group had no resting wall motion abnormalities, versus 6 patients (20%) in isolated CAE group who showed SWMA in resting 2D echocardiographic exams. Regarding tissue Doppler imaging, mean E' velocity was significantly lower in the CAE group and E/E' ratio was significantly higher in CAE group.

Mean global peak longitudinal strain was significantly lower in the CAE group with a value of (-16.49%) versus (-19.47%) in the control group, denoting that isolated CAE can cause subclinical harm to myocardial performance in the absence of other causes of LV systolic dysfunction.

In the current study, the majority of cases with coronary ectasia were males (83.3%), these results are in line with other studies like a study held in Tehran Heart Center on 229 patients with CAE, and the percentage of males among the CAE patients was 80%, showing a two-fold higher probability of CAE in men (p value < 0.001) [27]. In our study 76.7% and 66.7% of CAE group had hypertension and dyslipidemia respectively, which was significantly higher than the control group. These data matched what detected by **Lam and HO** [28] **and Yang *et al.*** [29]**.** On the contrary, diabetes was found only in 13.3% among patients with coronary ectasia while 50% of control group were diabetic, this finding matched the pooled analysis by **Huang *et al.*** [30] showing a reduced rate of diabetes amongst patients with CAE compared to those without, and diabetes might play a protective role for the development of CAE.

In this study, patients with isolated CAE had significantly lower LVEF as compared to control group with mean values (59.33 ± 9.09%) versus (63.13 ± 4.11%). As regards other echocardiographic parameters, LV dimensions and volumes were significantly higher in the CAE group. LV mass, LV mass index, LA volume and LA volume index were significantly higher in the CAE group. In a study carried by **Triantafyllidi *et al.*** [31] on 40 patients with CAE; left ventricular end-diastolic diameter (LVEDD), LV mass and LV mass index were significantly increased in CAE group compared to control group. However, in a study carried by **Mahmoud *et al.*** [23], there was no significant difference in the values of LA, LVEDD, LVESD, PW, IVS and LVEF between the two groups. Although, the values of LVEDD were higher in CAE group (47.5 ± 8.6 mm) than the control group (45 ± 4.9 mm) and the LVEF was lower in CAE group (58.5 ± 7.8%) than the control group (61.6 ± 5.2%) but this was statistically insignificant.

In the present study, there was no significant difference between the two groups regarding mean S' velocity, while the mean E' velocity was significantly lower in the CAE group (8.67 ± 2.29) compared with the control group (10.82 ± 2.61), similarly, E/E' ratio was significantly higher in the CAE group. These data matched a study carried by **Ozturk *et al.*** [32] on 50 CAE patients and 40 control subjects to evaluate left ventricular systolic asynchrony and their relationship with the Tei index using tissue Doppler imaging, The E' in the septal mitral annulus was decreased in their CAE group compared with the control group. Similar to our results, **Saglam *et al.*** [33] evaluated LV function in patients with CAE by pulsed-wave tissue Doppler imaging and demonstrated that E' in the septal and lateral mitral annuli was decreased compared with the control group. However, the same study found no statistically significant differences concerning S' and A' between the 2 studied groups.

We evaluated longitudinal LV function in patients with CAE by 2D speckle tracking echocardiography and found that global peak longitudinal strain was significantly lower among patients with isolated CAE, as its mean value was (-16.49%) versus (-19.47%) in the control group.

To our knowledge, there is paucity of data evaluating longitudinal LV functions among patients with isolated CAE. The first study was carried by **Aghajani *et al.*** [34] who evaluated longitudinal LV function in patients with CAE and vitamin D deficiency by 2D speckle tracking echocardiography comparing with subjects with vitamin D deficiency and normal coronary arteries. Their study found that the absolute value of longitudinal systolic strain was reduced in the patients with CAE (−14.0±2.7%) versus to (−15.4±2.3%) in the control group with (p value= 0.039). They also measured the strain rate in their study and found that the absolute values of systolic longitudinal strain rate (SRS), early diastolic longitudinal strain rate (SRE) and late diastolic longitudinal strain rate (SRA) were reduced in the patients with CAE and vitamin D deficiency compared with subjects with vitamin D deficiency and normal coronary arteries. After adjustment for the vitamin D level, these differences regarding the 2DSTE-derived indices of longitudinal LV function remained statistically significant. The absolute SRS values >1.2/s had 71.4% sensitivity and 64.5% specificity for the differentiation of CAE from non-CAE.

Study limitations:

Small study size and lack of follow-up to evaluate the prognostic value of the 2D speckle tracking echocardiography derived indices of LV function.

CONCLUSIONS

In our study, we have concluded that global peak longitudinal strain was significantly impaired in patients with isolated coronary artery ectasia denoting subclinical LV systolic dysfunction.

Consent of publications: Not Applicable.

Availability of data and material: All data including angiogram films and stored echocardiographic loops are available with the authors and in Ain Shams University Catheterization Lab and echocardiography records.

Competing interests: All authors declare that there are no conflicts of interests.

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