

Subendocardial Left Ventricular Dysfunction by Speckle-Tracking Strain Image in Asymptomatic Patients with Chronic Aortic Regurgitation and Normal Ejection Fraction

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Abstract

Background: Aortic regurgitation (AR) is the most common valvular heart disease. During asymptomatic phase, many changes in the left ventricle (LV) geometry, volume, wall stress, and LV wall thickness eventually ends up with LV myocardium dysfunction. The traditional echocardiographic parameters utilized for the detection of myocardial dysfunction and the subsequent timing of surgery are not sensitive enough to detect these changes in their early stage before an irreversible myocardial damage occurs. **Objective:** the objective of this study to demonstrate the presence of global longitudinal strain (GLS) abnormality in patient with chronic asymptomatic AR reflecting a subclinical left ventricular dysfunction. **Materials and Methods:** A total of 35 asymptomatic patients with chronic AR of different severity and preserved ejection fraction (EF) were compared with 35 age-matched control healthy subjects. **Results:** There was a statistically significant reduction in the GLS values in patient with AR regardless its severity compared with control ($P < 0.00$), despite the preserved EF. Also decreased GLS index to LV end diastolic volume in patients with chronic AR ($P < 0.00$). Furthermore, they exhibited significant increase ($P < 0.00$) in wall thickness, end-systolic volume, and LV mass in patients compared to the control group. **Conclusion:** GLS measured by speckle tracking for chronic asymptomatic AR was significantly lower than normal participants and may have potential role in timing of surgery and postoperative prognosis.

Keywords: Aortic regurgitation, ejection fraction, end-systolic volume and left ventricle mass, global longitudinal strain

INTRODUCTION

Aortic regurgitation (AR) is the backflow of blood from the aorta into the left ventricle (LV) during diastole owing to the incompetent aortic valve closure or any disorder of the valvular apparatus.^[1] AR can have chronic course or it may happen acutely, presenting as heart failure.^[2] AR was seen in <1% of patients in all strata younger than 70 years.^[3-5]

In chronic AR, the gradual left ventricular volume changes allow for compensatory changes to develop including LV dilatation and hypertrophy, resulting in a larger and more compliant LV, with larger capacity to carry a large stroke volume that can compensate for the regurgitant volume (Laplace law).^[6] During the early phase of chronic AR, the LV ejection fraction (EF) is kept with normal or even high than normal due to Frank-Starling mechanistic in response to an increased preload, keeping adequate peripheral perfusion and preventing the development of symptoms. However, asymptomatic patient still may develop irreversible LV dysfunction.^[6]

MATERIALS AND METHODS

A total of 35 patients (18 males and 17 females) with asymptomatic AR with similar number of healthy volunteers (24 males and 11 females) were included in the study. The group of patients were subdivided according to severity of AR in (7 patient mild, 21 moderate, and 7 severe AR). The exclusion criteria are as follows: those who are symptomatic, EF <55% by Simpson's method, concomitant significant other valvular disease, ischemic heart disease, hypertension, diabetes mellitus, patients with arrhythmia or conduction defects, history of previous heart surgery or valve implantation, and a body mass index ≥ 30 . Both

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groups underwent a detailed echocardiographic examination. The echocardiographic parameters were measured in keeping with the guidelines of the European society of echocardiography.

The patients with AR were classified into mild, moderate, and severe AR if they fulfill at least one criterion for each category Table 1.

Speckle tracking analysis: Event timing was done by electrocardiography and pulsed-wave Doppler on AV in apical five-chamber view to determine AV opening and closure in Figure 1.

Global longitudinal strain (GLS) by two-dimensional (2D) speckle tracking was assessed from apical parasternal long-axis, apical four-chamber, and apical two-chamber views. Region of interest is traced on the endocardium automatically or manually. GLS was calculated based on average strain from 17 segments (six basal, six mid, four apical, and the one true apex) using standard three apical views, respectively [Figure 2]. The frame rate was kept between 60 and 100 Hz.

RESULTS

A total number of 35 patients and 35 healthy age-matched controls were examined in this study, with age range from 18 to 69 years.

The GLS was shown to be significantly lower in AR group [Figure 3], a difference that was maintained through the whole spectrum of AR patient (mild, moderate, and severe) [Table 2], and a reduction that was proportional to the AR severity with significant difference between mild and severe, moderate, and severe ($P < 0.05$).

DISCUSSION

Table 3 The base line echocardiographic characteristics showed a highly significant difference in the echocardiographic parameters reflecting a significant volume overload in patient group (28 patient with moderate or severe AR), although the EF considered to be normal in all patient and control, it was significantly higher in the control group, a difference though with in normal might reflect a subtle structural changes in the AR group.^[7,8]

Table 1: Grading of aortic regurgitation severity according to EACVI

Parameters	Mild AR	Moderate AR	Severe AR
Semiquantitative			
VC width mm	<3 mm	3-6 mm	>6 mm
PHT ms	>500 ms	500-200	<200 ms
Quantitative			
EROA mm ²	<10 mm ²	10-30 mm ²	>30 mm ²
RV ml	<30ml	30-59 ml	≥60 ml

VC: Vena contracta, PHT: Pressure half-time, EROA: Effective orifice area, RV: Regurgitant volume, AR: Aortic regurgitation, EACVI: European association of cardiovascular imaging

Figure 3 shows a highly significant reduction in the GLS of the patient group compared to the control, this constant with other studies.^[8,9]

Table 2 shows a difference that was significantly maintained even in subgroup analysis compared with control that showed even in mild AR; a significant difference in the GLS index was seen in severe and moderate AR but not in mild AR.

The presence of the GLS abnormality in mild AR this may reflect the sensitivity to early delicate myocardial dysfunction, but might weakens the specificity of strain abnormality as a reflector of advanced mechanical changes

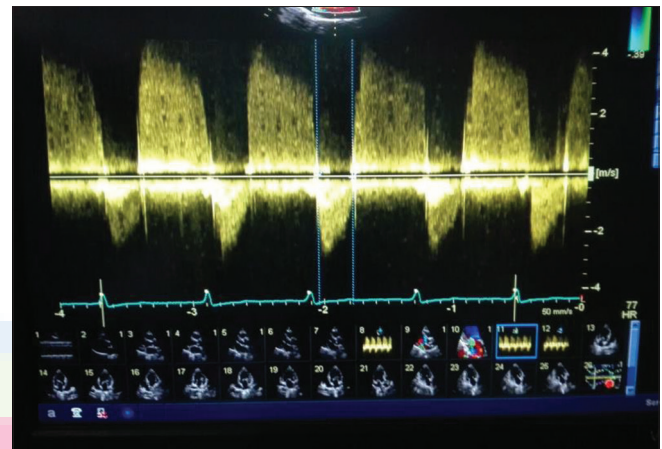


Figure 1: Event timing

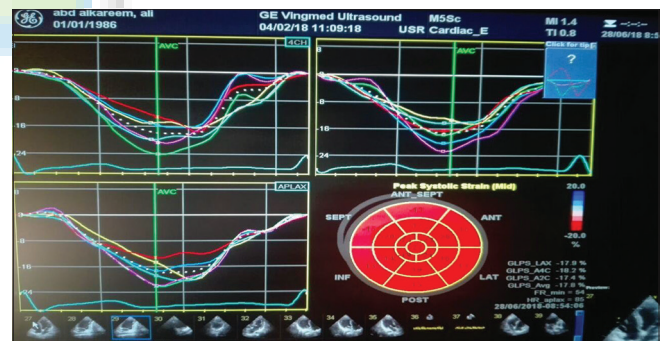


Figure 2: Reduced global longitudinal strain in chronic aortic regurgitation patient (global longitudinal strain = -17.8)

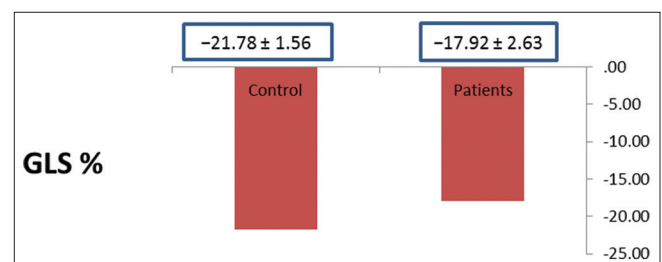


Figure 3: The difference in the left ventricle global longitudinal strain global longitudinal strain % in the control and patients groups, * = significant result

Table 2: The deferens in the left ventricle global longitudinal strain % and global longitudinal strain index between control and patients subgroup

Parameter	Control	Mild AR	Moderate AR	Sever AR	P
GLS average	-21.8±1.6	-20±1.7			<0.01
	-21.8±1.6		-18.1±2		<0.01
	-21.8±1.6			-15.4±2.5	<0.01
GLS index	-0.12±0.04	-0.12±0.01			>0.01
	-0.12±0.04		-0.096±0.01		<0.01
	-0.12±0.04			-0.07 ± 0.01	<0.01

GLS: Global longitudinal strain, AR: Aortic regurgitation

Table 3: The baseline clinical and echocardiographic characteristics of the studied patients and control groups

Parameter	Patient	Control	P
Age	45±16	41.17±8.7	0.1
BMI	25.08±2.8	24.7±1.7	0.4
BSA	1.73±0.14	1.72±0.12	0.6
PWT	0.97±0.2	0.83±0.1	<0.01
IVS	0.96±0.2	0.85±0.1	<0.01
LVESD	2.89±0.6	2.6±0.3	<0.01
EF	59.5±5.4	64.8±5.1	<0.01
ESV	44.2±15	32.6±6.3	<0.01
ESVI	25.7±8.5	18.6±6.2	<0.01
LVM	193.2±69	127.3±27	<0.01

PWT: Posterior wall thickness, IVS: Interventricular septum thickness, LVESD: Left ventricle end-systolic dimension, EF: Ejection fraction, ESV: End-systolic volume, ESVI: End-systolic volume index, LVM: Left ventricle mass, BMI: Body mass index, BSA: Body surface area

in the LV that might impact the need and timing of surgery, however when GLS was corrected to the end-diastolic volume EDV to overcome volume dependent deformation. the correlation was not significant in the mild AR group, while maintained its significance in both moderate and severe AR group.^[8,10]

CONCLUSION

The reduction in the GLS is a common finding in patients with asymptomatic chronic AR, and it was proportional to the severity of AR even when the EF and other 2D echocardiographic parameters fall within normal ranges or do not reach the traditionally defined limits for referral to surgery.

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Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. ECAVI textbook (European Association of Cardiovascular Imaging) Textbook of Echocardiography. 2nd ed. Edition, OXFORD, University Press; 2017.
2. Saura D, Peñafiel P, Martínez J, de la Morena G, García-Alberola A, Soria F, *et al.* The frequency of systolic aortic regurgitation and its relationship to heart failure in a consecutive series of patients. *Rev Esp Cardiol* 2008;61:771-4.
3. Maurer G. Aortic regurgitation. *Heart* 2006;92:994-1000. [medline].
4. Ortiz JT, Shin DD, Rajamannan NM. Approach to the patient with bicuspid aortic valve and ascending aorta aneurysm. *Curr Treat Options Cardiovasc Med* 2006;8:461-7.
5. Keane MG, Pyeritz RE. Medical management of Marfan syndrome. *Circulation* 2008;117:2802-13.
6. Lancellotti P, Tribouilloy C, Hagendorff A, Moura L, Popescu BA, Agricola E, *et al.* European association of echocardiography recommendations for the assessment of valvular regurgitation. Part 1: Aortic and pulmonary regurgitation (native valve disease). *Eur J Echocardiogr* 2010;11:223-44.
7. Wang SS. Austin Heart South, Sleep Disorders Center at Heart Hospital of Austin; UNC School of Medicine; 2017.
8. Marciniak A, Sutherland GR, Marciniak M, Claus P, Bijnsens B, Jahangiri M, *et al.* Myocardial deformation abnormalities in patients with aortic regurgitation: A strain rate imaging study. *Eur J Echocardiogr* 2009;10:112-9.
9. Ewe SH, Haack ML, Ng AC, Witkowski TG, Auger D, Leong DP, *et al.* Detection of subtle left ventricular systolic dysfunction in patients with significant aortic regurgitation and preserved left ventricular ejection fraction: Speckle tracking echocardiographic analysis. *Eur Heart J Cardiovasc Imaging* 2015;16:992-9.
10. El-Banna M, Gabra G, Bakr K, Soliman M, Adigopula S, Grapsa J, *et al.* United Arab Emirates, Cleveland Clinic Lerner College of Medicine, Cleveland, OH, USA. 2018.