ISSN: 3029-0732

Research Article

Journal of Cardiovascular and Cardiology

Speckle Tracking Echocardiographic Assessment of Adult Patients Presenting in A Private Health Facility in Jos, North Central Nigeria

Kumtap YC*, Chundusu CM, Okopi John, Enenche Austin, Sawa JI, Artu S, Oluwatosin O, Gomerep VS and Danbauchi SS

Department of Internal Medicine, Jos University Teaching Hospital, PMB 2076, Plateau State, Nigeria

***Corresponding author**
Kumtap YC, Department of Internal Medicine, Jos University Teaching Hospital, PMB 2076, Plateau State, Nigeria.

Received: August 12, 2025; **Accepted:** August 28, 2025; **Published:** September 08, 2025

ABSTRACT
Speckle Tracking Echocardiography (STE) is regarded as a more advance method of assessing ventricular systolic function over the older conventional techniques. It is an assessment of global and regional myocardial function using strain and strain rates.

Objectives: In this study, we compared STE as an assessment tool of left ventricular systolic function to Ejection fraction in adult patients. Chest pain, age, hypertension, diabetes mellitus and left ventricular diameter were parameters considered in a private health facility in Jos, central Nigeria.

Methods: A retrospective data from 25 adult patients from April to July 2021 who presented to a private facility was analyzed. All patients underwent transthoracic echocardiographic examination using the state of the act GE 'Vivid iq' machine. Both conventional echocardiography and STE were recorded. Strain analysis was according to American Heart Association (AHA) guidelines

Conclusion: This study lends credence to other studies which suggest that speckle tracking imaging better identifies regional systolic dysfunction compared to other traditional/conventional non-invasive methods.

Keywords: Speckle Tracking Echocardiography (STE), Global Longitudinal Strain

Introduction
Over the years, the cardiology community has identified the limitations of conventional techniques of Ejection Fraction (EF) from linear measurements [1]. Fractional Shortening (FS), Mitral Annular Plane Systolic Excursion (MAPSE), Tricuspid Annular Plane Systolic Excursion (TAPSE), Fractional Area Change (FAC), modified Simpson biplane method, Doppler assessment of stroke volume using LV outflow tract dimension and VTI, Rate of ventricular pressure rise calculated from continuous wave doppler of MR jet have all been used in the assessment of cardiac systolic function [1-3]. From previously being a research tool, speckle tracking has become of great help to clinicians to assess ventricular systolic function. This has been validated with respect to more complex, time-consuming and expensive techniques [4].

Speckle tracking imaging is a non-invasive ultrasound technique that allows an objective and quantitative assessment of global and regional myocardial function, independently from the angle of insonation and partly from cardiac translational movements [5-8].

Conventional echocardiographic estimation of segmental left ventricular contractility is routinely accomplished through visual interpretation of endocardial motion and myocardial thickening. This method is subjective and requires an experienced observer. Speckle tracking imaging software analyzes the deformation (change in shape) of the ventricular myocardium during a cardiac cycle using strain and strain rates [4]. Strain is thus a dimensionless index reflecting the total deformation of the myocardium during a cardiac cycle, as a percentage of its initial length/size. For mono-dimensional deformations,

Strain = $L_t - L_o / L_0$

Citation: Kumtap YC, Chundusu CM, Okopi John, Enenche Austin, Sawa JI, et al. Speckle Tracking Echocardiographic Assessment of Adult Patients Presenting in A Private Health Facility in Jos, North Central Nigeria. J Cardiovas Cardiol. 2025. 3(3): 1-4. DOI: doi.org/10.61440/JCC.2025.v3.42

Strain is positive if Lt is more than Lo (an object has lengthened) and negative if Lt is smaller than Lo (shortening) [4].

The 3-dmensional (3-D) arrangement of myocardial fiber bundles in the ventricle is complex, with fibers arranged to maximize the efficiency of cardiac contraction. Myocardial fibers are arranged in a helical and perpendicular orientation, with clockwise epicardial and counterclockwise endocardial fibers. The myocardium finally consists of three separate layers: transversely oriented mid-myocardium circular/circumferential fibers that wrap around both ventricles, the inner oblique layer (clockwise rotation) and the outer oblique (counterclockwise rotation) [9]. Most cardiac myofibers are oriented in the circumferential direction with a proportionally smaller number oriented in a longitudinal direction [10]. Three principal components contribute to systole: inward motion, longitudinal motion (base moving toward the apex) and differential rotation of apex and base (twisting). The deformation of myocardial segment during the cardiac cycle is complex and consists of normal deformation (longitudinal shortening/lengthening, radial thickening/thinning, and circumferential shortening/lengthening and shear deformation (base-apex twisting, epi-endo circumferential shear, and epi-endo longitudinal shear) [11].

Given the arrangement of the myofibers, strain can be assessed via Global longitudinal strain (GLS), Global circumferential strain (GCS), and Global Radial Strain (GRS) [1]. Each technique requires the operator to mark the endocardial and epicardial borders. Echocardiographic software tracks the movement of echocardiographic speckles during myocardial contraction. During systole, the shortening of the longitudinal and circumferential myocardial fiber length (assessed by GLS and GCS respectively) is denoted by negative values. Systolic radial myocardial fiber thickening (assessed by GRS) is denoted by positive values.

The clinical use of 2-D STE in cardiac assessment is widespread with demonstrated benefit in various cardiac conditions, including assessment of coronary ischaemia, assessment and prognostication of cardiomyopathies (Ischaemic and non-ischaemic), differentiation of hypertrophy(markedly reduced in HCM, mildly reduced in hypertensive hypertrophy and preserved in physiologic hypertrophy of an adaptive athlete's heart), assessment of subclinical LV dysfunction in valvular heart disease and monitoring of patients receiving chemotherapy [12-14]. Increased wall thickness due to cardiac amyloidosis causing infiltrative cardiomyopathy has a specific apical-sparing pattern [15].

GLS remains the predominant tool for clinical application because of its ease of use, reproducibility, time efficiency, and simplicity. Currently, GCS and GRS have limited clinical application and are predominantly research tools.

Methods

Data from adult patients from April to July 2021 who presented to a private health facility were retrospectively analyzed. The study included 26 adult patients. All patients underwent complete transthoracic echocardiographic examination with the machines (GE Vivid iq.). Examinations were analyzed off-line on dedicated workstations by experts. Images were obtained in the left lateral decubitus position according to the recommendations of the American Society of Echocardiography.

LV systolic function was determined by LV EF calculated using the Teicholz method. Normal EF was defined according to current adult guidelines with a cut-off of 55% [16]. Strain analysis was used to obtain regional and global longitudinal strain (GLS) of the left ventricle on three consecutive beats from each apical window (apical 4-chamber, 3-chamber and 2-chamber window: all taken at nearly identical heart rates) for each GLS analysis. In details, when adequate echocardiographic examinations were available defined as images with good image quality and frame rate > 50 frames per second [17]. Tracking of the myocardium was achieved through the combination of echocardiographic tracking of speckle signals, mitral annulus motion, tissue-blood border detection, and periodicity of the cardiac cycle using R–R intervals.

Accuracy of border tracking was visually confirmed by viewing the cardiac cycle with only border information displayed. If necessary, individual regions of the border were adjusted until the border was correctly tracked for each frame. Cardiac strain was used to calculate myocardial deformation and displayed it in a 17-segment model according to AHA guidelines [17].

Averaged segmental peak strain were calculated to obtain regional and global longitudinal strain. The software provides peak orthogonal deformation of the cardiac muscle during contraction, accordingly as in systole the myocardium reduces its wall length in the longitudinal planes, more negative values of longitudinal strains represent a better cardiac contraction. An avg GLPS of greater than -14 (>-14) was used as an abnormal finding.

An SPSS pack was used for comparing GLPS and LVEF values in the parameters considered

Results

Sixty (60%) of the population were made of males. The average age of the subjects was 55.40 ± 12.33 years.

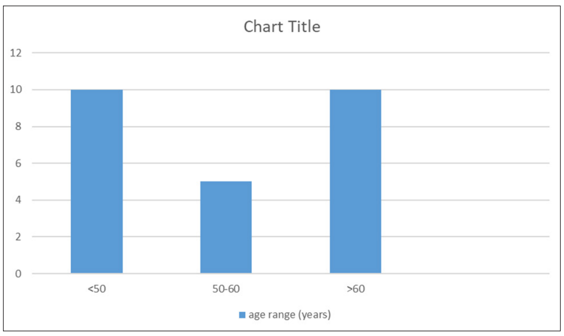

Figure 1: Demographic Characteristics of Participants

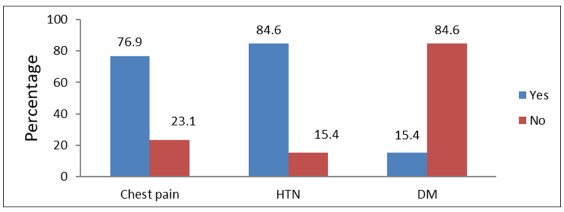

Figure 2: Percentages of subjects with pain hypertension and DM

Table 1: A 2X2 Relationship between LVEF and GLPS Avg

LVEF	GLPS Avg			χ2	p-value
	>-14 (abnormal)	<-14 (normal)	Total		
<50% (abnormal)	2(8.0)	0(0.0)	2(8.0)	5.590	0.018
>50 %(normal)	5(20.0)	18(72.0)	23(92.0)		
Total	7(28.0)	18(72.0)	25(100.0)		

Table 2: Proportions of subjects with normal GLPS and LVEF

Parameters		n	Normal GLPS Avg	Normal LVEF
Age	<50yrs	10	0.800	1.000
	51-60yrs	5	0.800	1.000
	>60yrs	10	0.600	0.800
Sex	male	16	0.625	0.889
	female	9	0.938	0.889
Pain		10	0.700	1.000
Hypertension		11	0.720	0.909
Diabetes Miletus		2	0.500	0.500
LVIDD >5.6cm		5	1.000	1.000

Discussion

Speckle tracking echocardiography is relativity a new procedure and the private health facility happens to be one of the first in this region to carry out and keep data relating to this procedure. Despite the small number of recorded data, findings were in agreement with data obtain from other centres and regions. The mean age of participants was 55.40 years ranging from 45-83 years with rear hospital male dominance of 64%. Most hospital presentations are dominated by women.

It was observed that a significant proportion had comorbidities, with 84.6% of them having hypertension and 15.4% having diabetes mellitus. This highlights the importance of considering these risk factors when assessing myocardial function using speckle tracking echo. Studies have shown the relationship of both hypertension and diabetes mellitus on cardiac function. Both disease conditions have detrimental effects on both systolic and diastolic function to varying degrees. An intresting finding from this study shows that 72% of patients with normal LV ejection fraction of greater than 50% had low average Global longitudinal strain values of less than 14%. It should be noted that LV systolic function results from a combination of longitudinal and circumferential myofibre shortening. GLS assess the function of longitudinally oriented fibres which are most vulnerable to myocardial disease because of their subendocardial location. Stokke et al using mathematical modelling, validated by clinical echocardiographic data, to study the relationship between LVEF to STE, found out that for each percentage change in GCS, there was a 1.6-fold larger effect on LVEF [18]. It could be seen in the study that the sensitivity of LVEF and avg GLPS was not the same, Stokke et al also reported that reduced LV cavity size or increased wall thickness diminished the longitudinal and circumferential shortening required to maintain the LVEF [18]. In particular, a 1-cm increase in LV wall thickness or a 100-mL decrease in LV end-diastolic volume reduced the global systolic shortening required to maintain LVEF by 3.0 and 2.1 percentage points respectively. Thus, in myocardial diseases with thickened walls or small ventricular cavities (eg, hypertrophic cardiomyopathy, cardiac amyloidosis), LVEF may be preserved despite reductions in GLS and GCS. When we looked at this study LVEF was 90% normal and avg GLPS 72% normal in subjects with hypertension. For patients with impaired LVEF, GLS and LVEF have a linear relationship, with a GLS of 11% or 12% corresponding to an LVEF of 35% [19,20]. In contrast, GLS and LVEF have a curvilinear relationship in patients with normal LVEF [20]. Therefore, the ability of GLS to detect subclinical myocardial dysfunction is likely greatest for patients with normal LVEF, and the advantage of GLS over LVEF may be its sensitivity to detect early subclinical cardiomyopathy before LVEF declines. Findings of LVEF and GLC in our study supports this assertion.

Regional strain analysis is valuable for differentiating between the various pathologic conditions that can cause increased ventricular wall thickness. Both hypertension and diabetes mellitus can cause ventricular wall thickness. Mean inter-ventricular septal wall and LV posterior wall thickness in this study were 1.43±0.33 cm and 1.28±0.68 cm respectively, suggesting LV hypertrophy. Studies have shown that strain is markedly reduced in hypertrophic cardiomyopathy, only mildly reduced in hypertensive hypertrophy, and preserved in the physiologic hypertrophy of an adaptive athlete's heart [12].

Average GLS in apical 4-chamber view in this study is -13.25±9.80 %. Suggesting a mild reduction but wide range.

Our study also showed that more patients with DM had reduced GLS score of less than 14% compared to patients with Hypertension.

Conclusion

This study lends credence to other studies which suggest that speckle tracking imaging better identifies regional systolic dysfunction compared to other traditional/conventional non-invasive methods. This ability to detect subclinical LV dysfunction makes 2-D STE a valuable tool in the assessment of all cardiac patients. It has the potential to better define prognosis and, hence, alter patient management to improve prognosis in patients with sub-clinical disease.

References

1. Sushil AL, Jonathan Chan, Patricia A. Pellikka. Echocardiographic Assessment of Left Ventricular Systolic Function: An Overview of Contemporary Techniques, Including Speckle-Tracking Echocardiography. 2019. 94: 125-138.
2. Braunwald's. Heart Disease, A Text book of cardiovascular Medicine, 10th edition. Elsevier Sanders.
3. Lang RM, Bierig M, Devereux RB. Recommendations for chamber quantification: a report from the American Society of Echocardiography's Guidelines and Standards Committee and the Chamber Quantification Writing Group, developed in conjunction with the European Association of Echocardiography, a branch of the European Society of Cardiology. J Am Soc Echocardiogr. 2005. 18: 1440-1463.

4. Iacopo F, Nicola RP, Veronica S, Lorenzo C, Vitantiono Di B. Speckle Tracking Imaging, Principles and Clinical Applications: A review for Clinical Cardiologists. 2016. 19: 85.
5. Dandel M, Lehmkuhl H, Knosalla C, Suramelashvili N, Hetzer R. Strain and strain rate imaging by echocardiography – basic concepts and clinical applicability. Curr Cardiol Rev. 2009. 5: 133-148.
6. Blessberger H, Binder T. NON-invasive imaging: two-dimensional speckle tracking echocardiography: basic principles. Heart. 2010. 96: 716-722.
7. Blessberger H, Binder T. Two-dimensional speckle tracking echocardiography: clinical applications. Heart. 2010. 96: 2032-2040.
8. Storaa C, Aberg P, Lind B, Brodin LA. Effect of angular error on tissue Doppler velocities and strain. Echocardiography. 2003. 20: 581-587.
9. Streeter DD, Spotnitz HM, Patel DP, Ross J, Sonnenblick EH. Fiber orientation in the canine left ventricle during diastole and systole. Circ Res. 1969. 24: 339-347.
10. Streeter DD Jr, Spotnitz HM, Patel DP, Ross J Jr, Sonnenblick EH. Fiber orientation in the canine left ventricle during diastole and systole. Circ Res. 1969. 24: 339-347.
11. Pitt B, Zannad F, Remme WJ. The effect of spironolactone on morbidity and mortality in patients with severe heart failure: Randomized Aldactone Evaluation Study Investigators. N Engl J Med. 1999. 341: 709-717.
12. Afonso L, Kondur A, Simegn M. Two-dimensional strain profiles in patients with physiological and pathological hypertrophy and preserved left ventricular systolic function: a comparative analyses. BMJ Open. 2012. 2.
13. Kearney LG, Lu K, Ord M. Global longitudinal strain is a strong independent predictor of all-cause mortality in patients with aortic stenosis. Eur Heart J Cardiovasc Imaging. 2012. 13: 827-833.
14. Plana JC, Galderisi M, Barac A. Expert consensus for multimodality imaging evaluation of adult patients during and after cancer therapy: a report from the American Society ofEchocardiography and the European Association of Cardiovascular Imaging. J Am Soc Echocardiogr. 2014. 27: 911-939.
15. Phelan D, Collier P, Thavendiranathan P. Relative apical sparing of longitudinal strain using two-dimensional speckle tracking echocardiography is both sensitive and specific for the diagnosis of cardiac amyloidosis. Heart. 2012. 98: 1442-1448.
16. Lang RM, Badano LP, Mor-Avi V. Recommendations for cardiac chamber quantification by echocardiography in adults: an update from the American Society of Echocardiography and the European Association of Cardiovascular Imaging. J Am Soc Echocardiogr. 2015. 28: 1-39.
17. Mondillo S, Galderisi M, Mele D. Speckle-tracking echocardiography: a new technique for assessing myocardial function. J Ultrasound Med. 2011. 30: 71-83.
18. Stokke TM, Hasselberg NE, Smedsrud MK. Geometry as a confounder when assessing ventricular systolic function: comparison between ejection fraction and strain. J Am Coll Cardiol. 2017. 70: 942-954.
19. Stanton T, Leano R, Marwick TH. Prediction of all-cause mortality from global longitudinal speckle strain: comparison with ejection fraction and wall motion scoring. Circ Cardiovasc Imaging. 2009. 2: 356-364.
20. Onishi T, Saha SK, Delgado-Montero A. Global longitudinal strain and global circumferential strain by speckle-tracking echocardiography and feature-tracking cardiac magnetic resonance imaging: comparison with left ventricular ejection fraction. J Am Soc Echocardiogr. 2015. 28: 587-596.