RESEARCH ARTICLE

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Global Longitudinal Strain by Speckle-tracking Echocardiography in Detection of Subclinical Left Ventricular Systolic Dysfunction in Patient with Severe Organic Mitral Regurgitation and Normal Ejection Fraction

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Abstract

Background and Aim: Primary mitral regurgitation (MR) is a common valvular disorder with significant long-term morbidity if untreated. Conventional echocardiographic indices, such as left ventricular ejection fraction (LVEF) and chamber dimensions, may overestimate ventricular performance and fail to detect early myocardial impairment. Speckle-tracking echocardiography (STE)–derived global longitudinal strain (GLS) has emerged as a highly sensitive parameter for the detection of subclinical systolic dysfunction. To investigate the role of GLS in the early identification of subclinical LV systolic dysfunction in individuals presenting with severe primary MR and preserved LVEF.

Materials and Methods: This study included 100 subjects: 50 with severe MR and normal LVEF, and 50 matched controls. Comprehensive echocardiographic assessment included M-mode, Simpson's biplane, tissue Doppler imaging, and two-dimensional STE (2DSTE). GLS values were derived from 18 myocardial segments and expressed as a bull's-eye map.

Results: Cases with MR had substantially impaired GLS relative to controls (-17.8±3.1 vs. -21.3±2.1; $P < 0.001$). All strain parameters were substantially lower among cases. In contrast, LVEF, measured by both M-mode and Simpson's method, showed no marked variation between groups ($P > 0.05$). Receiver operating characteristic analysis demonstrated that GLS had superior discriminative performance, with sensitivity of 82% and specificity of 66% at a cut-off of -20.35% (area under the curve 0.821, 95% confidence interval 0.737-0.905, $P = 0.001$).

Conclusion: 2DSTE-derived GLS is an effective parameter for the identification of subclinical LV systolic dysfunction in the context of severe primary MR with preserved EF. Its incorporation into clinical practice may optimize the timing of surgical referral before irreversible myocardial damage occurs.

Keywords: Mitral regurgitation, left ventricular dysfunction, echocardiography, global longitudinal strain

INTRODUCTION

Mitral regurgitation (MR) represents one of the most common valvular heart disorders in developed nations. According to European and American guidelines, surgical intervention for primary MR is recommended when patients present with symptoms of severe MR, exhibit left ventricular (LV) systolic dysfunction defined by an ejection fraction (EF) below 60%, demonstrate LV dilatation with an LV end-systolic dimension (LVESD) higher than 45 mm, or develop pulmonary arterial hypertension or new-onset atrial fibrillation (AF).[1]

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If only these parameters are considered, subtle myocardial remodeling secondary to increased filling pressures is frequently overlooked, as the LV and left atrium (LA) are initially able to withstand the hemodynamic stress. The recommended thresholds for intervention are relatively high, corresponding to advanced systolic dysfunction, which risks delaying surgical management until irreversible myocardial injury has developed. Therefore, chronic primary MR may be clinically silent for prolonged periods, owing to compensatory changes in LV and LA structure and function, despite substantial regurgitation.[1]

LVEF is widely used in clinical practice as a key parameter for decision-making in patients with MR. Nonetheless, LVEF describes the volumetric change in the LV from diastole to systole, without considering the direction of blood ejection or the intrinsic contractile properties of the myocardium. In MR, a substantial portion of LV output is directed toward the low-pressure LA rather than the systemic circulation, which limits the accuracy of LVEF in assessing true systolic function. Consequently, LV contractility may be overestimated despite the presence of myocardial impairment caused by volume overload.[2]

Echocardiographic assessment of global longitudinal strain (GLS) offers potential value in detecting early myocardial dysfunction in MR, which may be overlooked when relying solely on volume-based indices such as LVEF.[3]

LV-GLS reflects myocardial longitudinal function by quantifying the percentage change in fiber length relative to its original length. Speckle-tracking echocardiography (STE) is the standard method for obtaining GLS, and GLS is increasingly used in routine practice. This parameter provides valuable insight into subclinical LV systolic dysfunction and may aid in optimizing follow-up strategies and determining the appropriate timing for intervention. [4]

Accordingly, this investigation aims to evaluate LV function and detect early subclinical dysfunction in patients with severe primary MR, using GLS derived from STE.

METHODS

Design and Population

This cross-sectional investigation was carried out at Fayoum University Hospital and enrolled 50 patients with severe primary MR and preserved EF, as determined by conventional echocardiography, along with 50 sex- and age-matched healthy volunteers who underwent structured history-taking, physical examination, 12-lead electrocardiogram (ECG), and comprehensive transthoracic echocardiography confirming normal chamber size, valvular structure and function, and preserved EF, with no more than trivial MR. Eligible patients were consecutively enrolled during the study period, February-July 2025.

The study adhered to international ethical standards and local regulatory requirements. Ethical approval for the study was granted by the Faculty of Medicine, Fayoum University Ethics Committee. All participants provided written informed consent (approval code: SCCREIRB-MEDICINFAYOM-GU-001-090225-028, date: 07.09.2015/registration date: 09.02.2025).

Eligibility Criteria

The inclusion criteria included patients aged 25-65 years with severe chronic primary MR, preserved EF, and only insignificant symptoms. Exclusion criteria were as follows: mild or moderate MR; severe MR with EF <55%; significant involvement of other cardiac valves; ischemic heart disease; hypertrophic, dilated, or restrictive cardiomyopathy; hypertension; diabetes mellitus; and AF.

Preserved LVEF for study eligibility was defined as LVEF ≥55% at rest, assessed by the modified biplane Simpson method (with supportive M-mode assessment). Patients with severe MR and LVEF <55% were excluded.

All Cases Were Subjected to the Following

Clinical Assessment

A comprehensive medical history was recorded for every case. This was followed by a thorough general and cardiac examination, including the documentation of vital signs. A standard 12-lead ECG was also performed.

Transthoracic Echocardiography

Echocardiographic studies were conducted using a GE Vivid E95 ultrasound system with advanced cSound image-processing technology and an M5Sc probe. Standard 2D, M-mode, and Doppler imaging included parasternal long- and short-axis views, together with apical four-chamber, two-chamber, and long-axis views. The etiology and severity of MR were assessed. Severity grading was based on color Doppler parameters, including jet area and extent, effective regurgitant orifice area (EROA), and vena contracta width, along with the proximal isovelocity surface area method. In addition, left atrial diameter and volume were measured. To minimize vendor-related variability, all echocardiographic acquisitions and strain analyses were performed using the same vendor platform (GE Vivid E95) throughout the study.

LV Dimensional, Functional, and Tissue Doppler Measurements

LV end-diastolic dimension and LVESD were obtained using 2D M-mode, whereas LV end-diastolic volume, LV end-systolic

volume, EF, fractional shortening (FS), and stroke volume (SV) were evaluated using both M-mode and the modified biplane Simpson method. In addition, pulsed-wave Doppler-based tissue Doppler imaging (TDI) was performed to measure systolic myocardial velocity (Sa) at the lateral and septal mitral annuli.

Two-dimensional Speckle-tracking Echocardiography (2DSTE)

For speckle-tracking analysis, apical four-chamber, two-chamber, and long-axis views were recorded over three consecutive cardiac cycles. GLS was quantified during an end-expiratory breath-hold, with frame rates of 40-80 frames/s obtained by optimizing sector width and image depth, without the use of dual focusing. GLS is reported using the conventional negative sign convention. For categorical interpretation, normal GLS was defined as ≤-18% (more negative), borderline GLS as >-18% to ≤-16%, and impaired GLS as >-16% (less negative). For correlation and receiver operating characteristic (ROC) analyses, GLS was also analyzed as the absolute magnitude (|GLS|), with lower |GLS| indicating worse longitudinal function.

Offline analysis was performed using the vendor-specific software on the same platform, which automatically generated GLS values and a bull's-eye map of all 18 myocardial segments from the three apical views. Offline GLS analysis was performed with partial blinding: observers were blinded to clinical data, but complete blinding to group allocation was not feasible because of obvious MR features on the echocardiographic images.

GLS values were reported using the conventional negative-strain notation (more negative values indicate better longitudinal systolic deformation). Based on prior reference values using the same vendor/platform, preserved GLS was defined as ≤-18% (absolute value ≥18%). Borderline GLS was defined as -18% <GLS≤-16%, and impaired GLS as >-16%.

Statistical Analysis

After coding and double data entry into Microsoft Access, the data were statistically analyzed using SPSS version 22.0 (SPSS Inc., Chicago, IL, USA) on Windows 7. Frequencies and percentages were used to summarize categorical variables, while continuous variables were described using mean ± standard deviation. The Shapiro-Wilk test was applied to assess normality. Independent-samples t-tests were used to compare two groups, while one-way ANOVA was used when more than two groups were involved. The chi-square test was used to determine associations between categorical variables. Pearson's correlation coefficient was used to measure relationships among quantitative variables. Statistical significance was defined as $P < 0.05$. ROC curve analysis was performed to evaluate the ability of GLS and LVEF to discriminate patients with severe primary MR from healthy controls. The ROC-derived cutoff represents the value that best separates the two groups in this dataset, thereby maximizing sensitivity and specificity, and should not be interpreted as a universal "normal/abnormal" GLS threshold. Multiple linear regressions were used to test the association between quantitative dependent and independent variables and predictive risk factors.

RESULTS

Fifty cases presenting with severe chronic primary MR and preserved EF were recruited, along with 50 age- and sex-matched healthy controls. Age and sex distributions were comparable between the two groups, with no substantial variation detected ($P > 0.05$) Table 1.

Among cases of severe primary MR, rheumatic etiology was the most frequent (52%), followed by mitral valve (MV) prolapse (22%), degenerative disease (20%), and flail MV leaflets (6%). The mean heart rate (HR) was 77±12 beats/min and mean systolic blood pressure (SBP) was 124.4±11.7 mmHg. EF was 66.7%±5.7 when measured by M-mode and 62.7%±4.6 by Simpson's technique. The mean end-systolic diameter (ESD) was 3.2±0.4 cm. Tissue Doppler parameters included a mean lateral S wave of 8.9±1.5 cm/sec and a mean septal S wave of 7.6±1.3 cm/sec. The mean EROA for MR severity was 0.61±0.28 cm² Table 2.

The study revealed a substantial reduction in all echocardiographic strain parameters among cases ($P < 0.001$).

Table 1. Baseline demographic and echocardiographic characteristics of the study population

Variable	Cases (n=50)	Controls (n=50)	*P*-value	Significance
Age (years), Mean ± SD	45.7±11.7	45.8±10.8	0.9	NS
Sex, number (%)				
Male	18 (36)	14 (28)	0.52	NS
Female	32 (64)	36 (72)		
EF, Mean ± SD				
EF (M-mode)	66.7±5.7	65.8±3.3	0.33	NS
EF (Simpson)	62.7±4.5	64.1±3.4	0.08	NS

EF: Ejection fraction, NS: Not significant, SD: Standard deviation, n: Number

In the case group, GLS showed no significant correlation with age or vital signs ($P > 0.05$). Notably, 30% of MR cases had impaired GLS, 26% had borderline values, and 44% had non-impaired GLS. GLS was substantially negatively correlated with left atrial volume index (LAVI), right ventricular systolic pressure (RVSP), end-diastolic volume, end-systolic volume, end-diastolic diameter, and ESD ($P < 0.05$), indicating that increases in these measures were associated with a worsening of GLS. Conversely, no marked correlations were observed between GLS and LA diameter, SV, FS, or EF ($P > 0.05$). A substantial positive correlation was identified between GLS and the lateral and septal S waves ($P < 0.05$), suggesting that higher tissue Doppler systolic velocities were associated with improved GLS. While no substantial associations were found between GLS and vena contracta width or jet area, a marked correlation with EROA was detected Table 3, Figure 1 and Figure 2.

Cases exhibited a marked reduction in longitudinal strain in the apical four-chamber, apical two-chamber, and apical long-axis views, all of which reached statistical significance ($P < 0.001$). The average GLS was -17.8±3.1 for cases versus -21.3±2.1 for controls, indicating a significant intergroup difference ($P < 0.001$) Table 4.

The specificity and sensitivity of EF, whether measured by M-mode or Simpson's method, were not statistically significant

Table 2. Etiology, vital signs, and echocardiographic characteristics of cases with severe primary MR

Variable	Mean	SD
Etiology of MR (number and frequency %)		
Mitral valve prolapse	11	22%
Rheumatic heart disease	26	52%
Flail MV leaflets	3	6%
Degenerative	10	20%
Vital signs		
HR (beat/min)	77	12
SBP (mmHg)	124.4	11.7
DBP (mmHg)	73.2	8.8
Echocardiography measures		
SV (mL)	83.6	30.1
FS (%)	39.4	12.4
LA diameter (cm)	4.03	0.72
LAVI (mL/m²)	61	31
EF by M-mode	66.7	5.7
EF by Simpson	62.7	4.6
RVSP (mmHg)	25.3	6.9
EDV (mL)	123.8	43.9
ESV (mL)	41.2	17.4
EDD (cm)	5	0.66
ESD (cm)	3.2	0.47
Tissue Doppler measures		
Lateral S wave (TDI) (cm/sec)	8.9	1.5
Septal S wave (TDI) (cm/sec)	7.6	1.3
MR severity parameters		
Vena contracta (cm)	0.78	0.15
Jet area (cm)	12.1	3.3
EROA (cm²)	0.61	0.28

MR: Mitral regurgitation, SV: Stroke volume, FS: Fractional shortening, LA: Left atrium, LAVI: Left atrial volume index, EF: Ejection fraction, EDD: End-diastolic diameter, RVSP: Right ventricular systolic pressure, DBP: Diastolic blood pressure, SD: Standard deviation, ESV: End-systolic volume, ESD: End-systolic diameter, TDI: Tissue Doppler imaging, EROA: Effective regurgitant orifice area, HR: Heart rate, EDV: End-diastolic volume, SBP: Systolic blood pressure, n: Number, MV: Mitral valve

Table 3. Correlation between GLS and clinical, echocardiographic, and MR severity parameters in case group

Variable	GLS		
	R	*P*-value	Significance
Age and vital signs			
Age (years)	-0.19	0.18	NS
HR (beat /min)	-0.03	0.82	NS
SBP (mmHg)	0.10	0.47	NS
DBP (mmHg)	0.19	0.18	NS
Echocardiography findings			
LA diameter (cm)	-0.21	0.15	NS
LAVI (mL/m²)	-0.48	0.003*	HS
SV (mL)	-0.23	0.10	NS
FS (%)	0.16	0.24	NS
EF (%)	0.11	0.45	NS
RVSP (mmHg)	-0.48	<0.001*	HS
EDV (mL)	-0.41	0.003*	HS
ESV (mL)	-0.45	0.001*	HS
EDD (cm)	-0.42	0.001*	HS
ESD (cm)	-0.48	<0.001*	HS
Tissue Doppler systolic lateral and septal wave			
Lateral S wave (TDI) (cm/sec)	0.35	0.01*	S
Septal S wave (TDI) (cm/sec)	0.45	0.001*	HS
MR severity measures			
Vena contracta	0.16	0.26	NS
Jet area	0.06	0.68	NS
EROA	0.41	0.001*	HS

*: Statistically significant $P < 0.05$, GLS: Global longitudinal strain, NS: Not significant, HS: Highly significant, S: Significant, LA: Left atrium, LAVI: Left atrial volume index, EDV: End-diastolic volume, SV: Stroke volume, FS: Fractional shortening, EF: Ejection fraction, RVSP: Right ventricular systolic pressure, ESV: End-systolic volume, EDD: End-diastolic diameter, SBP: Systolic blood pressure, ESD: End-systolic diameter, TDI: Tissue Doppler imaging, MR: Mitral regurgitation, EROA: Effective regurgitant orifice area, HR: Heart rate, DBP: Diastolic blood pressure

for assessing LV function and contractility in MR cases ($P > 0.05$). In contrast, LV-GLS demonstrated significant diagnostic value Table 4 and Figure 3.

ROC curve analysis was performed to assess the ability of GLS and LVEF to discriminate between patients with severe primary MR and healthy controls. GLS demonstrated strong discriminative performance, with an area under the curve of 0.821 [95% confidence interval (CI) 0.737-0.905, $P = 0.001$]. A cut-off value of -20.35% yielded 82% sensitivity and 66% specificity in identifying MR patients (i.e., GLS values that were less negative than -20.35% were more likely to be observed in the MR group). In contrast, LVEF measured by M-mode and Simpson's method showed limited discrimination ($P > 0.05$) Table 5 and Figure 3.

Multivariate linear regression analysis demonstrated that SBP, LA, EF by M-mode, EF by Simpson, septal S wave (TDI), and RVSP were significant predictors of GLS (*P*-value <0.05) Table 6.

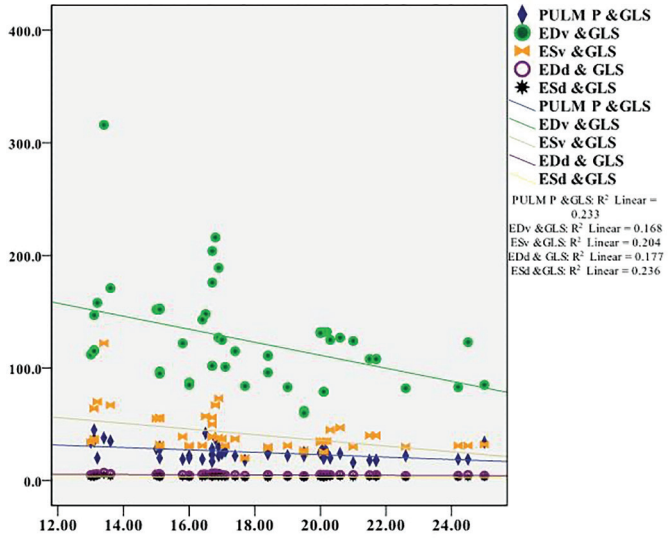

Figure 1. Correlation between GLS and echo-parameters in case group

GLS: Global longitudinal strain, EDV: End-diastolic volume, ESV: End-systolic volume, EDD: End-diastolic dimension/diameter, ESD: End-systolic dimension/diameter

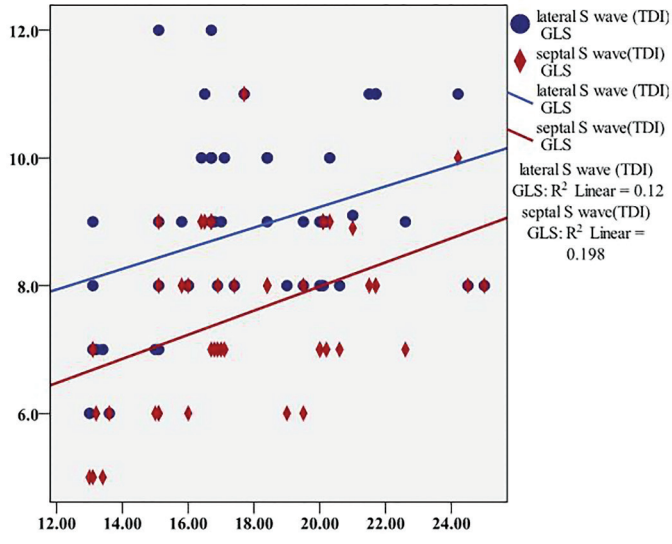

Figure 2. Correlation between GLS and septal and lateral S wave by TDI in case group

GLS: Global longitudinal strain, TDI: Tissue Doppler imaging

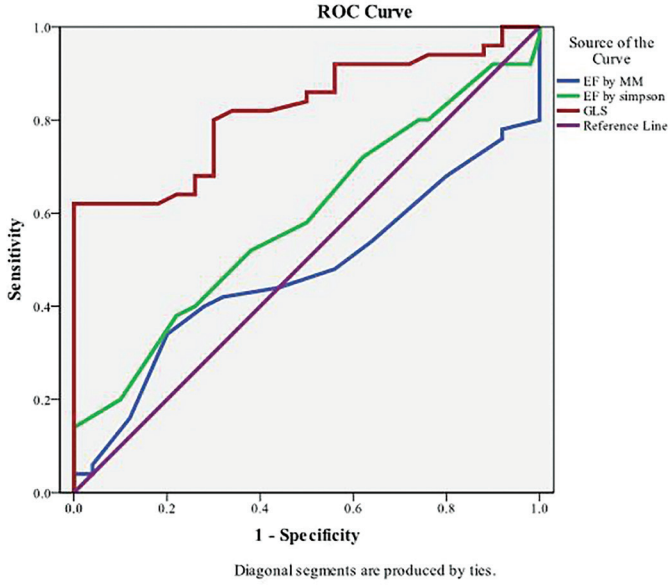

Figure 3: ROC curve for EF level and GLS assessment of LV function in cases of organic MR

ROC: Receiver operating characteristic, MR: Mitral regurgitation, EF: Ejection fraction, GLS: Global longitudinal strain, LV: Left ventricular, MM: M-mode

Table 4. Global and segmental longitudinal strain values in studied groups

Variables	Cases (n=50)		Controls (n=50)		*P*-value	Significance
	Mean	SD	Mean	SD		
APICAL 4CH LS	-18.1	4.1	-21.3	2.3	**<0.001***	**HS**
APICAL 2CH LS	-19.9	3.2	-21.1	2.4	**<0.001***	**HS**
APICAL LAX LS	-17.7	3.6	-21.1	2.5	**<0.001***	**HS**
GLS	-17.8	3.1	-21.3	2.1	**<0.001***	**HS**

*: Statistically Significant $P < 0.05$, CH: Chamber, LS: Longitudinal strain, GLS: Global longitudinal strain, LAX: Long axis, SD: Standard deviation, HS: Highly significant, n: Number

DISCUSSION

Primary MR carries an unfavorable long-term prognosis when left untreated, with MV repair or replacement being the only definitive therapy for severe disease. According to European and American guidelines, surgical intervention is recommended for patients with severe MR who present with symptoms, LV dilatation or dysfunction, elevated pulmonary pressures, or new-onset AF. However, conventional echocardiographic parameters frequently fail to identify early structural changes associated with elevated filling pressures, and the guideline thresholds for referral correspond to advanced systolic and structural impairment. As a result, cases are often referred for surgery only in the late stages, when irreversible myocardial damage has already occurred.[1]

A widely accepted hypothesis suggests that in several cardiac disorders, the earliest functional impairment occurs in the longitudinal fibers of the endocardium and epicardium, while the mid-wall circumferential fibers remain relatively preserved or may even compensate by enhanced circumferential shortening. This adaptive mechanism maintains LVEF despite the decline in longitudinal performance. Consequently, speckle-tracking-derived LV-GLS is considered a valuable marker, as it provides a sensitive measure of early myocardial dysfunction.[5]

As this is a cross-sectional case-control study, our findings demonstrate associations between GLS and echocardiographic and MR severity parameters at a single time point, and cannot be used to infer causality or directly evaluate prognosis or postoperative outcomes in our cohort.

Table 5. ROC curve analysis of ejection fraction and global longitudinal strain

Variable	Sensitivity	Specificity	AUC	Cut-off point	*P*-value (CI 95%)
EF (mm)	48%	44%	47.1%	66.5	0.62 (35.5-58.8)
EF by Simpson	58%	50%	58.7%	64.5	0.14 (47.5-69.9)
GLS	82%	66%	82.1%	-20.35	**0.001* (73.7-90.5)**

*: Statistically significant $P < 0.05$, EF: Ejection fraction, GLS: Global longitudinal strain, CI: Confidence interval, AUC: Area under the curve

Table 6. Multivariate linear regression analysis to determine the power of different variables in prediction of GLS among study group

Model		Unstandardized coefficients		Standardized coefficients	*P*-value
		B	Standard error	Beta	
1	**(Constant)**	-19.692	9.141		0.038
	Age	-0.061	0.035	-0.231	0.090
	HR	0.027	0.033	0.102	0.429
	SBP	0.095	0.036	0.356	0.014*
	DBP	0.020	0.048	0.055	0.682
	SV	-0.004	0.015	-0.041	0.778
	FS %	0.031	0.032	0.126	0.328
	LA	1.402	0.589	0.325	0.023*
	EF by	-0.298	0.106	-0.542	0.008*
	EF by Simpson	0.610	0.119	0.893	0.001>*
	Lateral S wave (TDI)	-0.224	0.313	-0.104	0.480
	Septal S wave (TDI)	0.890	0.381	0.378	0.026*
	RVSP	-0.192	0.072	-0.423	0.012*
	Vena contracta	4.784	4.399	0.236	0.284
	Jet area	-0.069	0.152	-0.073	0.654
	PISA radius	-2.984	3.062	-0.184	0.337

*: Statistically significant $P < 0.05$, HR: Heart rate, SBP: Systolic blood pressure, DBP: Diastolic blood pressure, SV: Stroke volume, FS: Fractional shortening, LA: Left atrium, EF: Ejection fraction, RVSP: Right ventricular systolic pressure, GLS: Global longitudinal strain, PISA: Proximal isovelocity surface area

Our results showed that the mean strain values in the case group were -18.1±4.1 in the apical four-chamber view, -19.7±3.2 in apical two-chamber view, and -17.7±3.6 in the apical long-axis view, with a mean GLS of -17.8±3.1. Among these cases, 30% had impaired GLS, 26% had borderline values, and 44% had preserved GLS. All strain parameters were markedly lower in cases relative to controls ($P < 0.001$).

In contrast, our analysis identified a substantial inverse correlation between GLS and EROA (r=-0.41, $P = 0.001$). This observation corresponds with findings from Nguyen et al.[6], who likewise demonstrated a negative correlation between these parameters, with a coefficient of -0.710.

In the context of the present study, GLS showed a marked inverse correlation with LAVI (r=-0.48, $P = 0.003$). This observation concurs with the work of Santoro et al.[7], who evaluated 504 consecutive cases across varying severities of MR using comprehensive echo-Doppler assessment. Their analysis compared LV and LA sizes, pulmonary artery systolic pressure, and GLS between cases with mild MR (n=392) and those with moderate-to-severe MR (n=112), and also demonstrated a substantial negative correlation between GLS and LAVI ($P < 0.005$).

Our study demonstrated that sensitivity and specificity testing of EF, whether assessed by M-mode or the modified Simpson biplane method, were not statistically significant for evaluating LV function and contractility in MR cases ($P > 0.05$). In our cohort, GLS demonstrated superior discrimination between MR patients and controls compared with that of LVEF; a GLS cut-off of -20.35% provided 82% sensitivity and 66% specificity for distinguishing the groups. This cut-off reflects discrimination within our dataset and should not be interpreted as a universal definition of abnormal GLS.

Our results are in agreement with those of Riebel et al.[8], who performed a prospective cohort study involving 218 cases with varying degrees of MR severity. Baseline and serial six-monthly evaluations of LV-GLS were performed over a median follow-up of 30 months. The study demonstrated significantly lower baseline GLS values in moderate and severe MR compared with mild MR (19.5% and 19.1% vs. 22.3%, $P < 0.01$), despite comparable LVEF. Moreover, GLS decline was detected earlier (at 12 months) and was more substantial in moderate and severe MR (13.6% and 14.5%, respectively) than in mild MR (6.72%). Baseline GLS <18% and a relative GLS reduction exceeding 10% were independent predictors of composite outcomes (HR=1.59, 95% CI 1.17-2.86; HR=1.74, 95% CI 1.2-2.91; $P < 0.01$).

In their systematic review, Krupa and Lall[9] concluded that GLS is a valuable parameter for evaluating LV systolic function and offers prognostic significance for both clinical and echocardiographic outcomes following intervention. They found that GLS thresholds lower than -17.2% to -21% in primary MR and -7% to -9% in secondary MR correlated with poor prognosis. These observations suggest that routine application of GLS in the evaluation of severe MR cases may improve intervention planning and clinical outcome prediction.

Modaragamage Dona et al.[10], through a systematic review, established GLS as an independent prognostic marker for postoperative outcomes, with values reported between -17.9% and -21.7%. Their findings revealed a significant negative association between preoperative GLS and postoperative LVEF. Higher mortality was observed in cases with impaired baseline GLS, whereas early surgical intervention conferred improved long-term survival. Although prior studies suggest prognostic value, our study was cross-sectional and did not evaluate postoperative or long-term outcomes.

In our study, a significant positive relationship was identified between GLS and the lateral and septal S waves ($P < 0.05$), indicating that enhanced tissue Doppler systolic function corresponded to improved GLS. This result concurs with findings from Peverill et al.[11], who investigated 84 subjects (mean age 66±8 years; 29 males) with LVEF of 62±6% and GLS of -17.5±2.3%. They reported, through univariate analysis, that GLS was positively correlated with mitral annular systolic velocity (s') on TDI (r=0.28, $P < 0.01$) and long-axis systolic excursion (r=0.50, $P < 0.001$).

According to the literature, Bijvoet et al.[5] proposed that in asymptomatic cases with severe MR and preserved LVEF, impaired LV-GLS serves as a predictor of postoperative LV dysfunction following MV surgery. Impaired LV-GLS has been shown to correlate not only with a decline in LVEF within 30 days of surgery but also with long-term mortality, as confirmed by several large studies. Therefore, LV-GLS may represent a valuable parameter for clinical decision-making in this patient population.

In their investigation of 506 cases with severe chronic MR, Kim et al.[12] found LV-GLS to be a powerful predictor of clinical outcomes, including HF hospitalization, need for repeat MV intervention, and cardiac death. This prognostic role remained significant in multivariate analysis, independent of LV dysfunction, AF, and surgical approach. The study also established a link between reduced GLS and increased risk of all-cause mortality (HR 1.068, 95% CI 1.003-1.136; $P = 0.040$).

These findings underscore the utility of GLS, assessed by STE, in the early detection of LV dysfunction in patients with severe primary MR. Our results are consistent with prior research that evaluated LV function and structural parameters in this population. The study also reaffirms the superior feasibility and reproducibility of GLS compared with those of LVEF. Thus, incorporating GLS into routine clinical practice may provide valuable adjunctive criteria to guide surgical decision-making.

Study Limitations

This study has several limitations. The relatively small sample size may limit generalizability and may have resulted in underpowered analyses of smaller effects (e.g., LVEF), correlation testing, and ROC-derived cut-offs, as reflected by the CIs. Inclusion of patients >60 years could have influenced GLS, given the age-related decline in strain. Speckle-tracking GLS is inherently image-quality-dependent and vendor-dependent. Although a single platform improves internal consistency, it may limit comparability of absolute GLS thresholds across vendors or software. The etiology of MR was heterogeneous (predominantly rheumatic), and GLS may vary accordingly; therefore, pooling may have attenuated etiology-specific associations. Intra- and interobserver reproducibility was not assessed, and incomplete blinding during GLS analysis may have introduced observer bias. Finally, no a priori sample size/power calculation was performed; however, the observed between-group GLS difference (-17.8±3.1 vs. -21.3±2.1) was large, suggesting adequate power to detect GLS differences despite potential underpowering for more modest associations.

CONCLUSION

GLS by 2DSTE is valuable for identifying subclinical LV systolic dysfunction in patients with severe primary MR and preserved EF. Its incorporation into clinical practice may enhance timing of surgical referral before irreversible myocardial damage occurs. These observations are consistent with prior literature demonstrating the advantage of LV-GLS over EF in detecting subclinical myocardial impairment in MR. However, because this study is cross-sectional and includes a relatively small sample, our ROC and correlation findings should be considered supportive and hypothesis-generating rather than definitive; they warrant validation in larger prospective cohorts.

Ethics

Ethics Committee Approval: Ethical approval for the study was granted by the Faculty of Medicine, Fayoum University Ethics Committee (approval code: SCCREIRB-MEDICINFAYOM-GU-001-090225-028, date: 07.09.2015/registration date: 09.02.2025).

Informed Consent: All participants provided written informed consent.

Footnotes

Authorship Contributions

Surgical and Medical Practices: F.E.S.G., H.E., Concept: T.R., K.K., G.A., Design: F.E.S.G., Data Collection or Processing: G.A., Analysis or Interpretation: F.E.S.G., T.R., Literature Search: K.K., Writing: F.E.S.G., H.E.

Conflict of Interest: No conflict of interest was declared by the authors.

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