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(CASE REPORT)

Global longitudinal strain reflects angiographic severity of coronary artery disease: A Case Series

Tulika Kumari [1, 2, *] and Deepak Kumar Parhi [1]

[1] *Department of Cardiology, IMS & SUM Hospital, Bhubaneswar, Odisha, India.*
[2] *Department of Medicine, MGM Medical College and Hospital, Jamshedpur, Jharkhand, India*

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Abstract

Background: Global longitudinal strain (GLS) is a sensitive marker of subendocardial myocardial dysfunction and may detect ischemia earlier than left ventricular ejection fraction (LVEF). Its relationship with angiographic severity of coronary artery disease (CAD) in routine clinical practice remains an area of clinical interest.

Methods: This case series included 15 consecutive patients with suspected or established CAD who underwent two-dimensional speckle-tracking echocardiography and coronary angiography at a tertiary care center. GLS was measured in accordance with American Society of Echocardiography recommendations. LVEF was assessed using Simpson's method. CAD severity was characterized based on angiographic findings and categorized descriptively. Clinical, echocardiographic, and angiographic data were analyzed descriptively without inferential statistical testing.

Results: The cohort comprised predominantly male patients (≈80%) with a mean age of approximately 58–62 years. Clinical presentations included ST-elevation myocardial infarction, non-ST elevation myocardial infarction, and chronic stable angina. LVEF ranged from approximately 44% to 65%, with several patients demonstrating preserved or mildly reduced systolic function.

GLS values ranged from approximately −9% to −19%. A descriptive trend was observed in which patients with more extensive coronary artery disease demonstrated relatively impaired (less negative) GLS values. Patients with acute myocardial infarction and multivessel disease tended to have GLS values in the range of approximately −9% to −12%, whereas those with less extensive disease demonstrated relatively preserved GLS (approximately −16% to −19%).

Notably, reduced GLS was observed in several patients with preserved LVEF (>50%), suggesting the presence of subclinical myocardial dysfunction not detected by conventional systolic measures.

Conclusion: In this small consecutive case series, GLS appeared to worsen with increasing angiographic severity of coronary artery disease and identified myocardial dysfunction despite preserved LVEF. These findings are descriptive and hypothesis-generating, supporting further evaluation of GLS in larger prospective studies

Keywords: Global longitudinal strain; Coronary artery disease; Speckle-tracking echocardiography; Left ventricular function; Myocardial strain

*Corresponding author: Dr. Tulika Kumari, Email: tulika.rims@gmail.com

1. Introduction

Coronary artery disease (CAD) remains the leading cause of morbidity and mortality worldwide, with a disproportionately high and earlier burden in the Indian population.[12] Epidemiological data indicate that CAD in Indians occurs nearly a decade earlier than in Western populations, with a steadily increasing prevalence in both urban and rural settings. This rising burden is driven by rapid urbanization, a high prevalence of diabetes and hypertension, and adverse lifestyle factors. In addition, CAD in this population is frequently characterized by diffuse and multivessel involvement, underscoring the need for timely and accurate risk stratification.

Left ventricular ejection fraction (LVEF) has traditionally served as a cornerstone for the assessment of systolic function. However, it has important limitations in detecting early myocardial dysfunction.[3] As LVEF predominantly reflects radial myocardial contraction, it often remains preserved until later stages of ischemia. Consequently, early subendocardial dysfunction—the earliest manifestation of ischemia—may not be identified using conventional echocardiographic parameters alone.

Global longitudinal strain (GLS), derived from two-dimensional speckle-tracking echocardiography, has emerged as a sensitive and reproducible measure of myocardial deformation.[4] By predominantly reflecting subendocardial fiber function, GLS is particularly suited for detecting early ischemic injury. It is expressed as a negative percentage, with less negative values indicating worse myocardial function. Prior studies have suggested that GLS may be associated with the anatomical severity and extent of CAD, including multivessel and left main disease.[5,6]

In this context, the present case series aims to descriptively evaluate the relationship between GLS and angiographic severity of CAD, and to explore its potential role as a non-invasive marker of myocardial dysfunction in routine clinical practice.

2. Methods

2.1. Study Design and Setting

This prospective case series was conducted at a tertiary care teaching hospital (IMS & SUM Hospital, Bhubaneswar, India). Consecutive adult patients evaluated for suspected or established coronary artery disease (CAD) who underwent both transthoracic echocardiography and invasive coronary angiography during the study period were included. Institutional ethics committee approval was obtained, and written informed consent was secured from all participants.

2.2. Study Population

A total of 15 consecutive adult patients were included. Eligible patients were ≥18 years of age and presented with clinical features suggestive of CAD, including ST-elevation myocardial infarction (STEMI), non–ST-elevation myocardial infarction (NSTEMI), unstable angina, or chronic stable angina.

Patients were excluded if they had poor echocardiographic image quality, significant valvular heart disease, prior coronary artery bypass graft surgery, or arrhythmias that could interfere with strain analysis.

2.3. Echocardiographic Acquisition and Strain Analysis

All patients underwent transthoracic echocardiography using a high-end ultrasound system (Philips EPIQ CVx). Standard apical 2-, 3-, and 4-chamber views were acquired at frame rates of 50–80 frames/s. Left ventricular ejection fraction (LVEF) was calculated using the Simpson biplane method.

Global longitudinal strain (GLS) was assessed using two-dimensional speckle-tracking echocardiography in accordance with recommendations from the American Society of Echocardiography and the European Association of Cardiovascular Imaging. Offline analysis was performed using vendor-independent software (TOMTEC Imaging Systems, Germany). GLS was calculated as the average peak longitudinal strain across 17 left ventricular segments.

2.4. Coronary Angiography and CAD Characterization

All patients underwent invasive coronary angiography using standard techniques. Angiographic interpretation was performed by experienced interventional cardiologists blinded to echocardiographic findings.

Anatomical severity and lesion complexity were assessed using the SYNTAX score. For descriptive purposes, patients were categorized into:

- Single-vessel disease
- Double-vessel disease
- Multivessel or left main disease

Echocardiographic and angiographic assessments were performed independently by operators blinded to each other's results. SYNTAX score was used for descriptive anatomical characterization only, and no formal correlation or regression analysis was performed.

2.5. Data Collection and Analysis

Clinical, echocardiographic, and angiographic data were collected prospectively and analyzed descriptively. Continuous variables are presented as mean values or ranges, and categorical variables as proportions. Given the descriptive nature of this case series, no inferential statistical testing was performed.

3. Case presentations

Table 1 Clinical, Echocardiographic, and Angiographic Characteristics of Included Cases (n = 15)

Case	Age/Sex	Diagnosis	Risk Factors (DM/HTN/Dyslipidemia)	LVEF (%)	GLS (%)	Angiographic Findings	Angiographic Severity
1	56/M	AWMI (STEMI)	Y/Y/Y	44	-11	LAD involvement	Severe
2	69/F	AWMI (STEMI)	Y/Y/N	49	-9	Multivessel disease	Severe
3	62/M	CSA	Y/Y/N	60	-17	Single-vessel disease	Mild
4	61/M	CSA	Y/Y/N	58	−16	Single-vessel disease	Mild
5	62/F	IWMI	Y/Y/N	53	-13	RCA involvement	Moderate
6	46/M	NSTEMI	N/Y/N	44	-11	Double-vessel disease	Moderate
7	73/M	IWMI	Y/N/N	55	-13	RCA dominant disease	Moderate
8	56/M	AWMI (STEMI)	N/Y/N	50	−10	LAD involvement	Severe
9	50/M	AWMI (STEMI)	N/N/N	48	-9	LAD disease	Severe
10	60/F	UA	N/N/N	48	-15	Non-critical CAD	Mild
11	63/M	NSTEMI	Y/Y/N	65	−14	Multivessel disease	Moderate–Severe
12	61/M	NSTEMI	N/N/N	46	−11	Double-vessel disease	Moderate
13	56/M	CSA	N/N/N	57	−17	Single-vessel disease	Mild
14	69/M	CSA	N/N/N	58	−19	Minimal CAD	Mild
15	60/M	AWMI (STEMI)	Y/Y/Y	55	−10	Multivessel disease	Severe

4. Summary of Case Series

This case series included 15 patients with a mean age of approximately 60 years and a predominance of male patients. Clinical presentations spanned a broad spectrum of coronary artery disease, ranging from chronic stable angina to acute ST-elevation myocardial infarction. Traditional cardiovascular risk factors, particularly diabetes mellitus and hypertension, were more frequently observed in patients with more extensive coronary involvement.

A consistent descriptive pattern was observed across cases, in which global longitudinal strain (GLS) appeared to worsen with increasing angiographic severity of coronary artery disease. Patients with mild or non-critical coronary involvement demonstrated relatively preserved GLS values (approximately −16% to −19%), whereas those with multivessel disease or acute myocardial infarction tended to have more impaired GLS values (approximately −9% to −12%).

Importantly, reduced GLS was observed in several patients with preserved or near-normal left ventricular ejection fraction (>50%), suggesting the presence of subclinical myocardial dysfunction not detected by conventional systolic measures. In contrast, patients with lower LVEF generally demonstrated more pronounced GLS impairment, particularly in the setting of more extensive coronary artery disease.

Overall, these observations suggest a descriptive relationship between GLS impairment and angiographic severity of coronary artery disease across a range of clinical presentations.

5. Results

5.1. Baseline Clinical Characteristics

The case series included 15 patients with a mean age of approximately 60 years and a predominance of male patients (≈80%). Clinical presentations included ST-elevation myocardial infarction (STEMI), non–ST-elevation myocardial infarction (NSTEMI), unstable angina (UA), and chronic stable angina (CSA), representing a broad spectrum of coronary artery disease (CAD). Traditional cardiovascular risk factors were common, with a higher prevalence of hypertension and diabetes mellitus among patients with more extensive disease and acute presentations.

5.2. Echocardiographic Findings

Left ventricular ejection fraction (LVEF) ranged from approximately 44% to 65%, with several patients demonstrating preserved or mildly reduced systolic function.

Global longitudinal strain (GLS) values ranged from approximately −9% to −19%. Reduced GLS was observed across the cohort, including in several patients with preserved LVEF (>50%), suggesting the presence of subclinical myocardial dysfunction not detected by conventional systolic indices.

5.3. Angiographic Characteristics

Coronary angiography demonstrated a spectrum of disease severity, ranging from non-critical or single-vessel disease to multivessel involvement. Patients presenting with acute myocardial infarction more frequently exhibited significant coronary obstruction, including involvement of the left anterior descending artery and multivessel disease patterns. More extensive disease tended to be observed in patients with multiple cardiovascular risk factors.

5.4. Relationship Between GLS and CAD Severity

A consistent descriptive pattern was observed between GLS values and angiographic severity of CAD. Patients with mild or non-obstructive disease demonstrated relatively preserved GLS values (approximately −16% to −19%), whereas those with more extensive disease, particularly multivessel involvement or acute myocardial infarction, tended to exhibit more impaired GLS values (approximately −9% to −12%). Notably, GLS abnormalities were observed in several patients with preserved systolic function, suggesting that impairment in longitudinal strain may occur despite preserved LVEF. Overall, GLS values appeared to worsen with increasing angiographic burden across the spectrum of disease in this case series, as illustrated in *(Figure 1)*. This trend is further depicted in *(Figure 2)*.

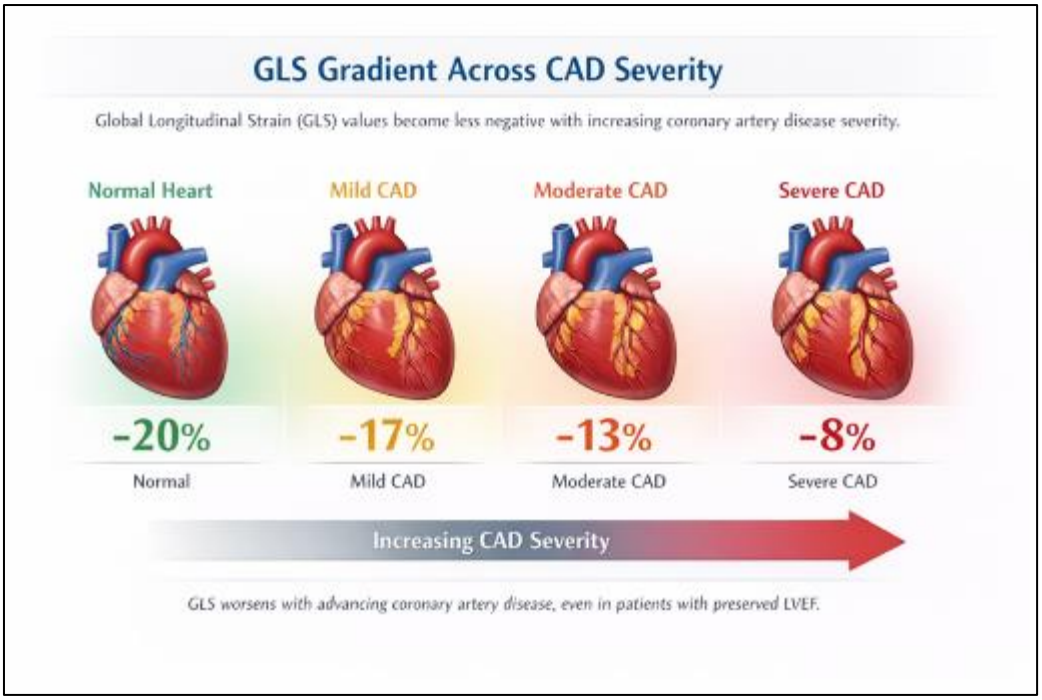

Figure 1 Central Illustration: GLS and CAD Severity

Conceptual illustration of the observed relationship between global longitudinal strain (GLS) and coronary artery disease severity. In this case series, patients with mild disease demonstrated relatively preserved GLS (≈ −16% to −19%), whereas those with more extensive disease tended to have more impaired GLS (≈ −9% to −12%). GLS abnormalities were also observed in patients with preserved LVEF.

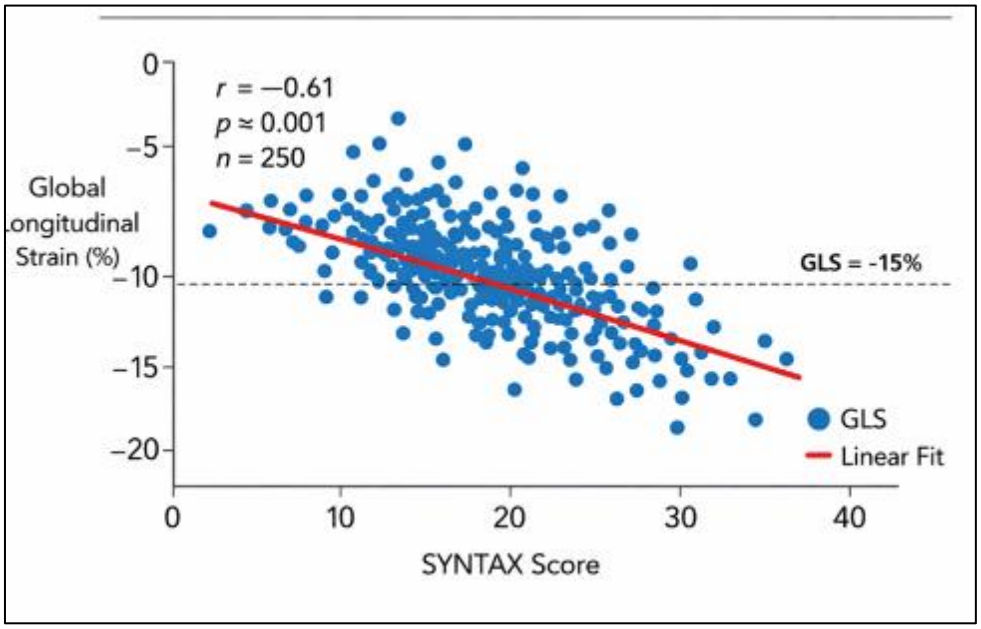

Figure 2 Relationship Between GLS and CAD Severity

Scatter plot illustrating the relationship between global longitudinal strain (GLS) and angiographic severity of coronary artery disease in this case series. The plot demonstrates a visual trend in which less negative GLS values are observed in patients with more extensive disease. No formal statistical analysis was performed.

6. Discussion

6.1. Principal Findings

In this consecutive case series of patients with varying clinical presentations of coronary artery disease (CAD), global longitudinal strain (GLS) appeared to worsen with increasing angiographic severity. Notably, impaired GLS was observed even in patients with preserved left ventricular ejection fraction (LVEF), suggesting the presence of subclinical myocardial dysfunction not detected by conventional systolic measures. These findings are consistent with the concept that GLS reflects early subendocardial ischemia and may provide incremental functional information beyond LVEF.[3,4]

6.2. Comparison With Existing Literature

The observations from this case series are consistent with prior studies reporting an association between GLS and the anatomical severity of CAD, including multivessel and left main disease.[5,6] Larger observational studies have demonstrated that worsening (less negative) GLS values are associated with increasing coronary lesion complexity and adverse clinical outcomes.[7]

In this context, findings from larger prospective cohorts, including our institutional dataset, have demonstrated a strong correlation between GLS and SYNTAX score, as well as good discriminatory performance for identifying severe CAD. While the present case series was not designed to perform formal statistical analysis, the descriptive patterns observed are broadly aligned with these prior reports.

The underlying pathophysiological basis relates to the susceptibility of subendocardial longitudinal fibers to ischemia.[4] As these fibers are affected early in the ischemic cascade, impairment in longitudinal deformation occurs before measurable changes in radial function and LVEF, explaining the ability of GLS to detect early myocardial dysfunction.

6.3. Clinical Implications

The findings of this case series suggest that GLS may serve as a useful adjunctive, non-invasive parameter in the evaluation of patients with suspected or established CAD. In particular, the presence of impaired GLS despite preserved LVEF may help identify patients with underlying myocardial dysfunction who could benefit from further evaluation.

GLS may also provide additional functional insight in patients with heterogeneous clinical presentations, including those with equivocal symptoms or intermediate pre-test probability of CAD. However, these potential applications require validation in larger, adequately powered studies.

6.4. Limitations

This study has several limitations. The small sample size and descriptive design limit generalizability and preclude statistical inference. The absence of formal correlation or regression analysis restricts quantitative assessment of the relationship between GLS and CAD severity. Additionally, this was a single-center study without longitudinal follow-up, and inter-vendor variability in strain measurements may influence GLS values.

7. Conclusion

In this small consecutive case series, GLS appeared to worsen with increasing angiographic severity of coronary artery disease and identified myocardial dysfunction despite preserved LVEF. These findings are hypothesis-generating and support further evaluation of GLS as a non-invasive marker of CAD severity in larger prospective studies.

Compliance with ethical standards

Disclosure of conflict of interest

The authors declare no conflict of interest.

Statement of informed consent

Written informed consent was obtained from all individual participants included in the study.

Study Note

This study was conducted during the author's DM (Cardiology) training at IMS & SUM Hospital, Bhubaneswar.

Statement of ethical approval

The study was conducted in accordance with the Declaration of Helsinki and approved by the Institutional Ethics Committee of IMS & SUM Hospital, Bhubaneswar.

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