OPEN ACCESS

ISSN: 2835-9496

Bolognesi M (2026): 1353-1355
Ameri J Clin Med Re, 2026; 6(3): 100253
DOI: 10.71010/2835-9496/ajcmr-e253

Research Article

American Journal of Clinical and Medical Research

Global Longitudinal Strain in the Diagnostic Evaluation of Acute Myocardial Infarction: Strengths, Limitations, and Clinical Integration

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Citation: Bolognesi M (2026) Global Longitudinal Strain in the Diagnostic Evaluation of Acute Myocardial Infarction: Strengths, Limitations, and Clinical Integration. Ann Clin Med Cas Rep Rev: AJCMR-253.

Received Date: July 18, 2026; **Accepted Date:** July 23, 2026; **Published Date:** July 29, 2026

Abstract

The Global Longitudinal Strain (GLS) has emerged as a sensitive marker of left ventricular systolic dysfunction and a valuable adjunct in the diagnostic work-up of acute myocardial infarction (AMI). Because longitudinal fibers are predominantly subendocardial, GLS is particularly vulnerable to ischemia and can detect myocardial injury earlier than conventional echocardiographic parameters. This review summarizes the pathophysiological basis, diagnostic performance, and clinical utility of GLS in AMI—especially in inferior-wall infarction, where traditional echocardiography often underestimates dysfunction. Structured tables and text-based figures are included to support clinical application.

Keywords: *Global longitudinal strain; myocardial infarction; speckle-tracking echocardiography; inferior MI; ischemia; myocardial deformation imaging.*

Introduction

Accurate and timely diagnosis of acute myocardial infarction remains a cornerstone of cardiovascular medicine. While ECG and biomarkers are essential, imaging plays a crucial role in confirming myocardial injury, assessing its extent, and guiding management. Conventional echocardiography, although widely available, suffers from operator dependency and limited sensitivity in early ischemia, particularly in the inferior wall.

Speckle-tracking echocardiography (STE) and Global Longitudinal Strain (GLS) provide quantitative assessment of myocardial deformation. GLS abnormalities often precede visible wall-motion abnormalities and correlate with infarct size and prognosis (1,3,4). Despite these advantages, GLS is underutilized in acute settings.

Pathophysiological Basis

Longitudinal fibers, located in the subendocardium, are the most vulnerable to ischemia (1). Early impairment leads to reduced longitudinal shortening and less negative GLS values.
During acute ischemia:
- longitudinal strain decreases early (2,3)
- abnormalities follow a coronary territorial pattern (4)
- global GLS may remain near-normal in small inferior infarcts (5)

Figure 1 — Textual schematic of myocardial fiber vulnerability
Myocardial Fiber Architecture (Longitudinal Layer)

• Location: Subendocardium
• Function: Longitudinal shortening (GLS)
• Vulnerability: Highest to ischemia
• Mechanism: Early impairment → GLS becomes less negative
• Consequence: Territorial strain abnormalities appear before WMA

Longitudinal fibers are located predominantly in the subendocardium, the myocardial layer most susceptible to ischemia. Consequently, GLS is an early marker of ischemic injury.
During acute ischemia:
- Longitudinal shortening decreases → GLS becomes less negative
- Regional strain abnormalities follow a territorial coronary distribution
- Global GLS may remain near-normal in small infarcts, especially inferior ones

This makes GLS particularly suited to detecting subendocardial injury and differentiating ischemic from non-ischemic patterns.

GLS in Inferior Myocardial Infarction

Inferior MI is diagnostically challenging due to suboptimal acoustic windows and subtle wall-motion abnormalities. GLS enhances diagnostic confidence by providing objective, territorial strain abnormalities (4,5).
Figure 2 — Typical Bull's Eye Pattern in Inferior MI (Textual Representation)
Bull's Eye (GLS) – Inferior MI

Anterior	Normal / mildly reduced
Anteroseptal	Normal
Septal	Normal
Inferoseptal	↓↓ (depending on RCA/Cx)
Inferior	↓↓↓ (territorial hallmark)
Inferolateral	↓↓ (variable)
Lateral	Normal / mildly reduced
Apical cap	Normal or mildly reduced

Legend: ↓ mild reduction | ↓↓ moderate | ↓↓↓ severe

Inferior-wall infarction presents unique diagnostic challenges. Acoustic windows are often suboptimal, wall-motion abnormalities may be subtle, and compensatory hyperkinesia of non-ischemic segments can mask dysfunction.
Typical GLS pattern in inferior MI
- Marked reduction in strain in basal, mid, and apical inferior segments

- Possible extension to infero-lateral or infero-septal segments
- Global GLS mildly reduced (–14% to –16%)
- Clear territorial pattern, unlike myocarditis or artifacts

Diagnostic Performance

GLS demonstrates high sensitivity for subendocardial injury and correlates with infarct size, microvascular obstruction, and myocardial salvage index on CMR (4,6,9). Reduced GLS predicts adverse remodeling, heart failure, arrhythmic risk, and long-term mortality (8).

Table 1 — Diagnostic Strengths of GLS in AMI

Feature	Diagnostic Value
Early detection	Identifies ischemia before WMA appear
Territorial mapping	Localizes culprit artery (RCA/Cx)
Sensitivity	High for subendocardial injury
Correlation with CMR	Infarct size, MVO, MSI
Prognostic value	Remodeling, HF, mortality
Utility in inferior MI	Outperforms visual WMA

Correlation with CMR

GLS correlates with:
- infarct size
- microvascular obstruction
- myocardial salvage index

Prognostic value

Reduced GLS predicts:
- adverse remodeling
- heart failure
- arrhythmic risk
- long-term mortality

Differentiation from Non-Ischemic Conditions

Strain patterns differ significantly between ischemic and non-ischemic injury (5,6).

Table 2 — Strain Patterns in Ischemic vs Non-Ischemic Injury

Condition	Strain Pattern	Distribution
Ischemic MI	Territorial ↓ strain	Coronary anatomy
Myocarditis	Patchy ↓ strain	Non-territorial
Takotsubo	Apical or mid-ventricular ↓↓	Non-coronary
Artifacts	Single-segment ↓	Non-reproducible

Limitations

Limitations include vendor variability, load dependency, arrhythmias, and dependency on image quality—particularly in the inferior wall (7,10).

Figure 3 — Limitations of GLS (Textual Summary)

Limitations of GLS

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1. Vendor variability (software differences)
2. Image quality dependency (inferior wall)
3. Load dependency (BP, afterload)
4. Arrhythmias reduce reproducibility
5. Not a standalone diagnostic tool

Clinical Integration

GLS adds value in equivocal wall-motion abnormalities, early chest-pain triage, MINOCA, preserved EF, and inferior MI (5,8).

Table 3 — Clinical Scenarios Where GLS Adds Value

Scenario	Added Value of GLS
Equivocal WMA	Objective quantification
Early chest pain triage	Detects subtle ischemia
MINOCA	Differentiates ischemia vs myocarditis
Preserved EF	Identifies high-risk patients
Inferior MI	Improves diagnostic confidence

Future Directions

Future developments include AI-driven strain analysis, 3D strain, fusion imaging, and improved standardization across vendors (7,10).

Figure 4 — Future Developments in Strain Imaging

Future Directions in GLS

• Automated AI-driven strain analysis
• 3D strain for improved reproducibility
• Fusion imaging (Echo + CMR/CT)
• Machine-learning ischemia signatures
• Standardization across vendors

Conclusion

GLS represents a significant advancement in the echocardiographic evaluation of AMI. In inferior MI—where traditional imaging is often inconclusive—GLS provides a sensitive, reproducible, and anatomically coherent assessment of myocardial injury. While not a replacement for comprehensive imaging or clinical evaluation, GLS adds meaningful diagnostic and prognostic value and should be considered an essential component of modern echocardiographic practice.

HIGHLIGHTS

▪ Global Longitudinal Strain (GLS) detects ischemia earlier than wall-motion analysis, especially in inferior myocardial infarction.
▪ Territorial strain abnormalities provide objective localization of the culprit artery, improving diagnostic confidence in acute settings.
▪ GLS correlates with infarct size, microvascular obstruction, and long-term outcomes, offering incremental prognostic value.
▪ In inferior MI, GLS outperforms conventional echocardiography, which often underestimates dysfunction due to suboptimal acoustic windows.
▪ Integration of GLS into acute echocardiographic workflows enhances early triage, risk stratification, and differentiation from non-ischemic injury.

Conflict of Interest Statement

The author declares no conflicts of interest related to the content of this manuscript.

Funding Statement

This research received no external funding.

Ethical Approval

Not applicable. This article is a narrative review and does not involve human subjects or identifiable data.

Data Availability Statement

No new data were generated or analyzed in this study.

Author Contributions

Massimo Bolognesi conceived the topic, performed the literature review, drafted the manuscript, and approved the final version.

Acknowledgments

No acknowledgments to declare.

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