

A prospective observational study for the assessment of left ventricular systolic function by comparing Simpson's biplane method and global longitudinal strain method in pre and post operative percutaneous coronary intervention patients

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Abstract

Background:

The Global Longitudinal Strain method is one of the sensitive markers to assess LVSF accurately when compared to Simpson biplane method. The reliability and precision of assessment of myocardial motion by Simpson biplane method and myocardial deformation differ from the volume-based measurements. For the measurement of myocardial function, the evaluation of GLS from speckle tracking analysis of 2D echocardiography has emerged as a therapeutically viable substitute for Simpson biplane method. The usefulness of GLS as a supplementary parameter to LVEF for integration into standard clinical practice is evaluated.

Methods:

A prospective observational study was done in 100 CAD patients who underwent PCI were included in this study after obtaining informed consent from each patient and ethical committee approval. Echocardiography was performed for the patients, and LVEF was measured by the Simpson's and GL strain methods. Accurate LV systolic function is statistically analyzed by using Pearson's correlation between pre- and post-PCI Simpson's and GLS methods. A significant difference for Simpsons and GLS was considered.

Result:

A statistically significant association was found between Simpsons and GLS measurements. Pre PCI Simpsons & GLS is 5.04×10^{-76} and post PCI Simpsons & GLS is 1.07×10^{-76} i.e., P value <0.05. Both the parameters were moderately correlated. GLS provides better predictivity than Simpsons biplane method.

Conclusion:

The study shows that GLS is more sensitive predictor to assess LVSF when compared to Simpson's method in pre & post PCI patients.

Key Words: Global longitudinal strain, Simpson's Biplane method, Myocardial deformation analysis, Percutaneous Coronary Intervention

Introduction:

The most important factor influencing morbidity and mortality in patients with coronary artery disease (CAD) is left ventricular systolic function (1). The preferred method of reperfusion in cases of acute myocardial infarction is primary percutaneous coronary intervention, or PCI (2). It remains difficult to determine how PCI affects systolic functions in patients whose baseline LV systolic function is compromised (3). Echocardiography is the most widely used non-invasive method for obtaining comprehensive information about the heart. Clinical practice frequently uses left ventricular ejection fraction (LVEF) as a measure of myocardial systolic function (4). Evaluating the prognosis of patients with CAD requires a precise assessment of LV function by calculating the LV volumes and the ejection fraction (EF) (5). Conversely, the Simpson's biplane approach is currently advised for the semi-quantitative evaluation of LVEF using 2D-TTE since it is thought to be more objective (6). In order to determine the LVEF, the Simpson's biplane approach divides the left ventricle into several equal cylinders from which the end-diastolic and end-systolic volumes can be measured (7). Since the Simpson's biplane approach involves either manual or semi-automated tracing of the left ventricular (LV) endocardial border, the evaluator's experience may also have an impact on the evaluation of LVEF. Global longitudinal strain measures the longitudinal myocardial deformation, is superior to the color kinesis technique, is more reproducible than the LVEF or wall motion score index, and the Simpson biplane, and has been shown to be successful in identifying LV myocardial ischemia (8). Recently, 2D-STE has become a practical method for automatically monitoring myocardial mobility during the whole cardiac cycle. It makes it possible to rebuild site-specific, angle-independent regional cardiac strain, strain rate, and velocity curves (9, 10). Strain is the integration of SR, which is defined as the difference in tissue velocities between two different sites along the echo beam's scan line. Additionally, strain and SR stand for tissue deformation or the fluctuating rate of tissue deformation. Strain and SR have been proposed as useful markers for assessing LV systolic and

diastolic function in a number of investigations (11, 12). GLS, which has been demonstrated to detect subclinical left ventricular failure in a variety of situations, including myocardial and valvular diseases, seems to be the most reliable metric (13). Because it is angle-independent and simpler to compute than the Simpson biplane method, speckle tracking echocardiography is superior to myocardial velocities in evaluating LVSF. It detects myocardial deformation, or strain. From A4c, A3c, and A2c views, the mean of 17 cardiac segments is used to determine GLS, which typically ranges from -18% to -21.5% (14, 15, 16). The objective was to compare the LV systolic function in pre- & post-PCI patients using the GL strain method and the Simpson's biplane method.

Methods And Materials:

This research was a prospective observational study conducted in the cardiology department at CESH. The IHEC gave their consent to the study. The study is to analyze the LV systolic function using Simpsons and GL strain in preoperative & postoperative PCI patients. **Inclusion criteria** include patient presented with DM, SHTN, DLP, and Hypothyroidism, Family history of CAD, smoker & alcoholic. **Exclusion criteria** include psychiatry patients & pregnancy. The patient was informed about the trial and given a format consent. A hospital-based prospective observational study was done in the cardiology department at CHRI, Kelambakkam. Data is collected in the year of November 2023–June 2024. The study considered 100 CAD patients. Using conventional echocardiography, ECG gated, 2D speckle tracking, and Simpson's biplane method was done using the Philips Affinity 50C machine in the Department of Cardiology. Echocardiography images were acquired in A4c, A3c, and A2c views for every individual. A4c, A3c, and A2c images of the left ventricle's endocardium were tracked. One day before and after PCI, transthoracic two-dimensional echocardiography was done at rest. Global longitudinal strain & Simpson's biplane is the method used to estimate the LV systolic function.

Statistical methods:

Pearson correlation was performed for comparing Simpsons biplane method EF & GLS percentage. P- value <0.05 are regarded as significant.

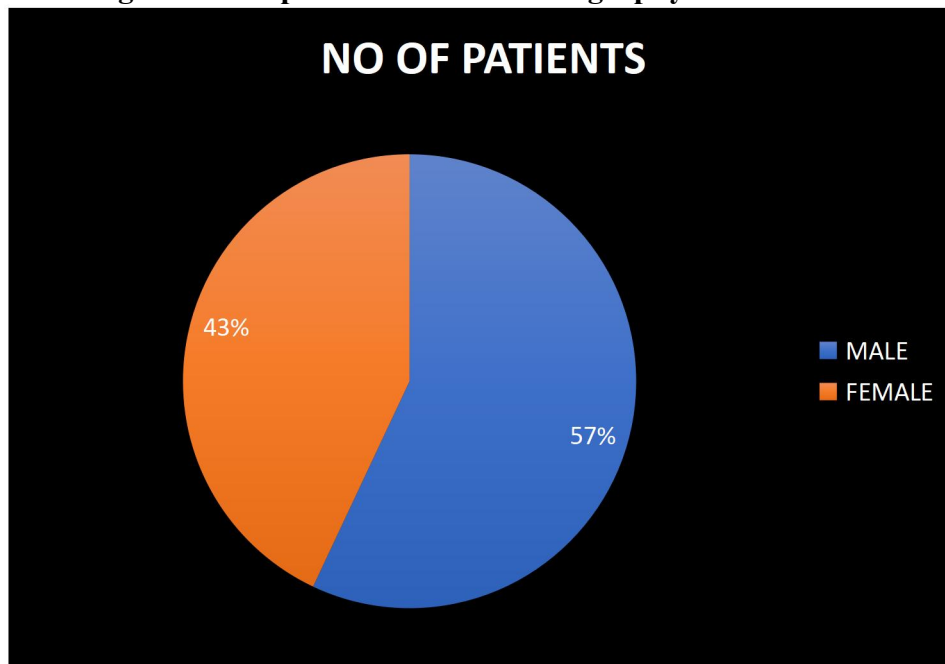
Result:

The study participants of 100 CAD patients were taken. Table 3.1. Represents the patient demography in which out of 100 CAD patients 57 male patients and 43 female patients were listed.

Table 3.1. Patient Demography

SEX	NO. OF PATIENTS	PERCENTAGE
MALE	57	57%
FEMALE	43	43%

Figure 3.1. Represents Patient Demography

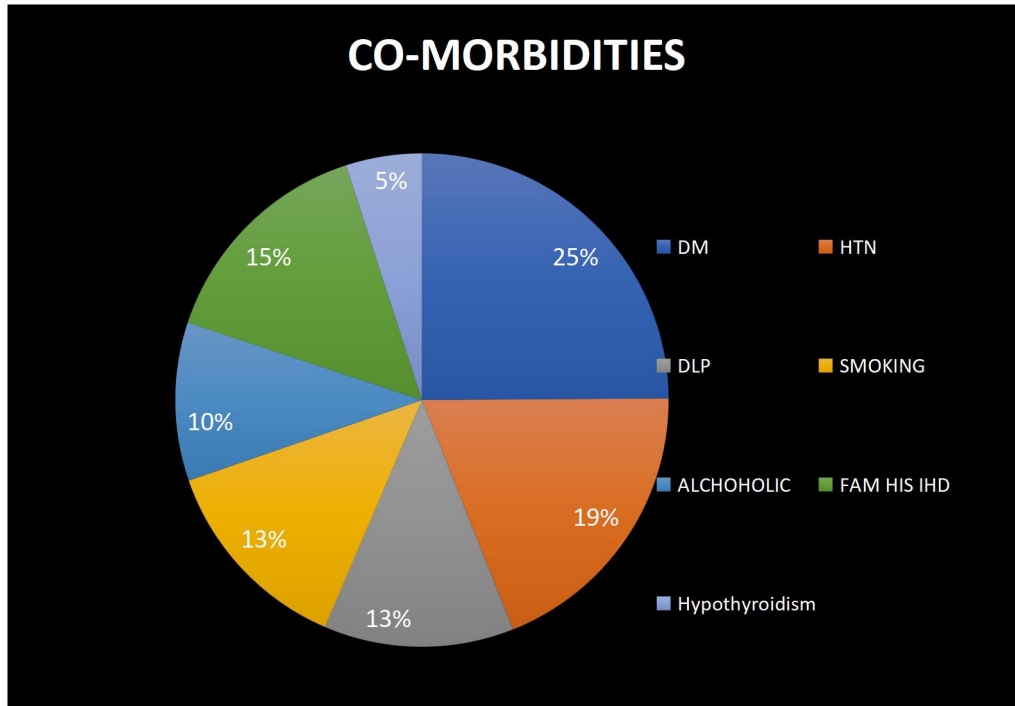


The clinical profile of patients including DM, HTN, DLP, Hypothyroidism, alcoholic, smoker and family history of IHD are listed in Table 3.2... Among those 25% patients had DM, 19% had HTN, 13% had DLP, 5% had hypothyroidism, 13% were smoker, 10% were alcoholic and 15% had family history

Table 3.2. Co Morbidities

CO-MORBIDITIES	NO OF PATIENTS
DM	60 (25%)
HTN	46 (19%)
DLP	30 (13%)
HYPOTHYROIDISM	12 (5%)
SMOKER	32 (13%)
ALCOHOLIC	25 (10%)
FAMILY HISTORY OF IHD	36 (15%)

Figure 3.2. Represents The Patient'S Comorbidities

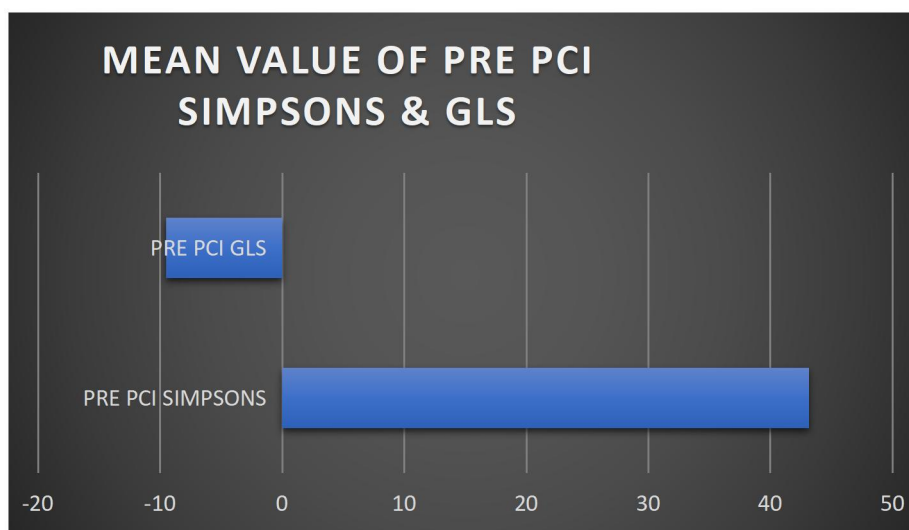


The average mean value of pre PCI by Simpson biplane method is 43.15 and pre PCI by GLS method is -9.483.

Table 3.3. Mean Representation Of Pre Pci Simpsons & GlS

PARAMETER	MEAN VALUE
PRE PCI SIMPSONS	43.15
PRE PCI GLS	-9.483

Figure 3.3. Mean Representation Of Pre Pci Simpsons & GlS

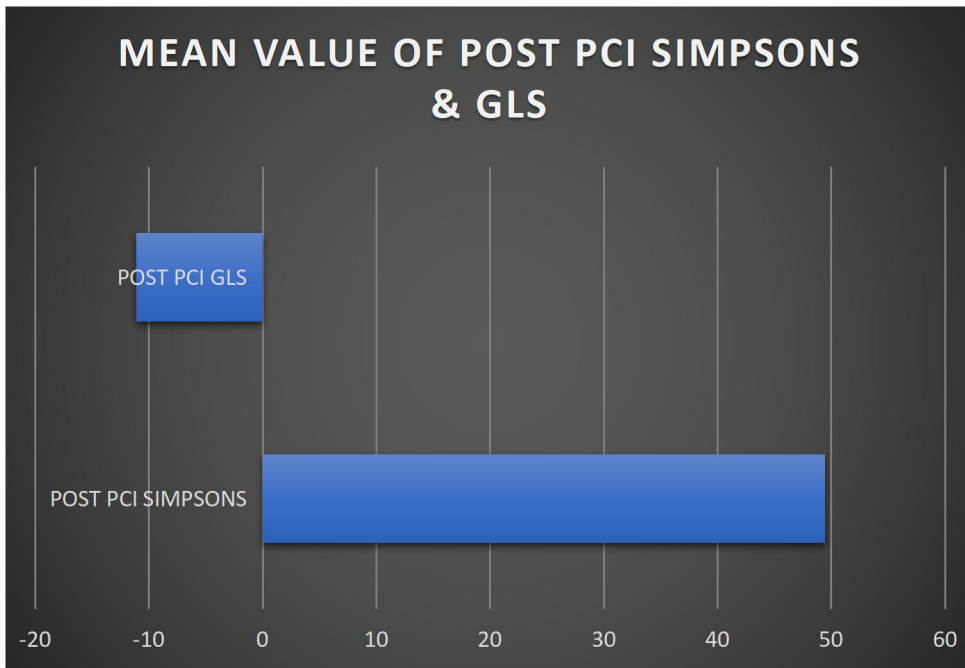


The average mean value of post PCI by Simpson biplane method is 49.42 and post PCI by GLS method is -11.091.

Table 3.4. Mean Representation Of Post Pci Simpsons & Gls

PARAMETER	MEAN VALUE
POST PCI SIMPSONS	49.42
POST PCI GLS	-11.091

Figure 3.4. Mean Representation Of Post Pci Simpsons & Gls



The correlation between Pre-PCI Simpsons & GLS -0.83181 which is a Moderately Negative correlation.

Table 3.5. Represents Correlation Between Pre Pci Simpsons& Gls

PARAMETER	r VALUE	CORRELATION
PRE PCI SIMPSONS & GLS	-0.83181	MODERATELY NEGATIVE CORRELATION

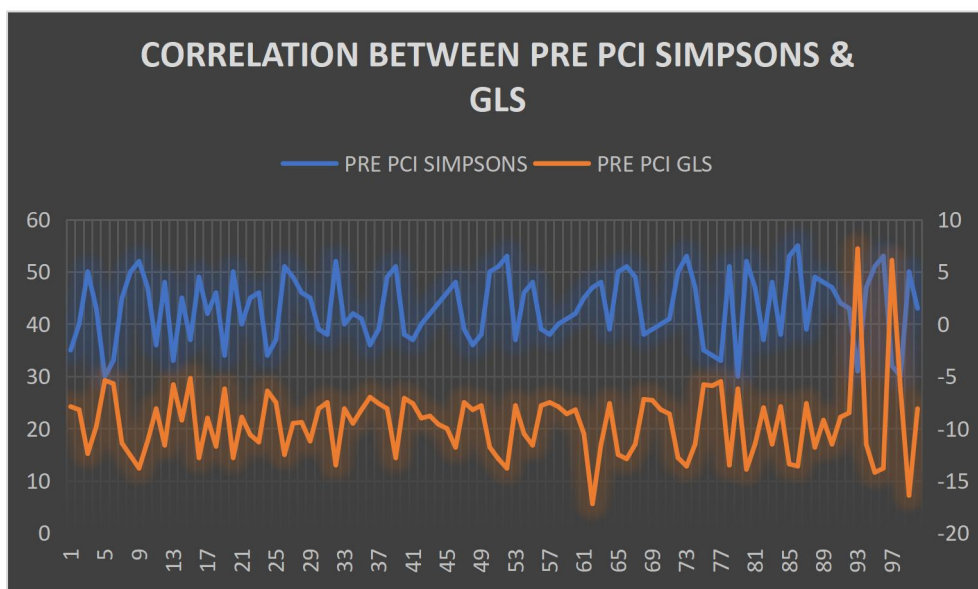


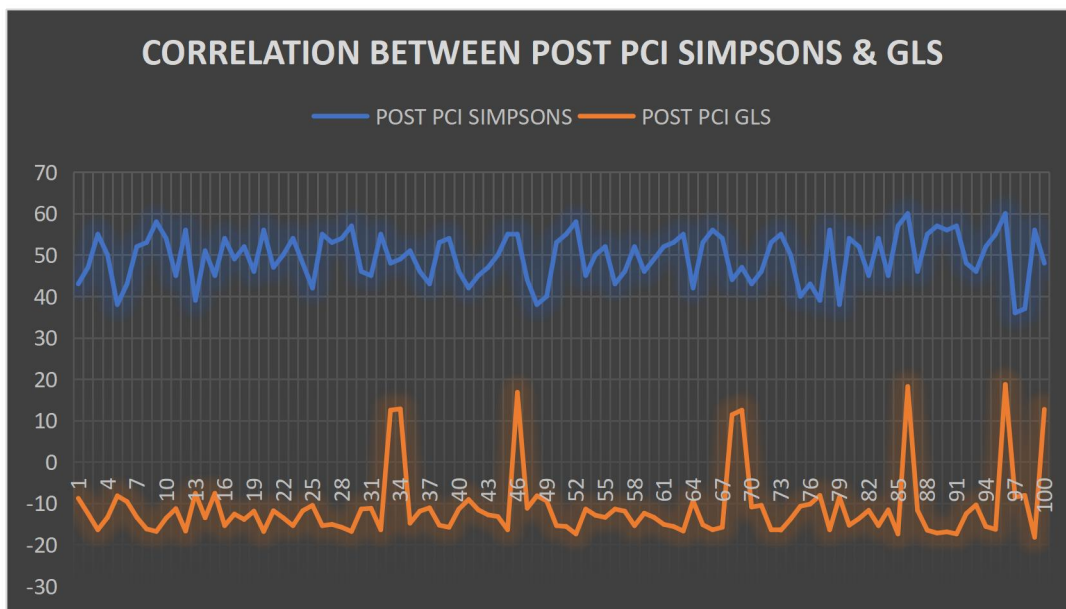
Figure 3.5. Represents The Correlation Between Pre Pci Simpsons & Gls

The correlation between post PCI Simpsons & GLS is -0.19092, which is a Moderately Negative correlation.

Table 3.6. Represents Correlation Between Post Pci Simpsons & Gls

PARAMETER	r VALUE	CORRELATION
POST PCI SIMPSONS & GLS	-0.19092	MODERATELY NEGATIVE CORRELATION

Figure 3.6 Represents The Correlation Between Post Pci Simpsons And Gls



The significance of correlation using P-value which is 5.04×10^{-76} and 1.07×10^{-76} respectively when P value is <0.05 .

Table 3.7. Represents Significance Of Correlation Using P Value

PARAMETERS	P VALUE
PRE PCI SIMPSONS & GLS	5.04×10^{-76}
POST PCI SIMPSONS & GLS	1.07×10^{-76}

Pearson Correlation Co Efficient Results:
 The correlation coefficient between pre-PCI Simpson’s and GLS, $r = -0.83181$
 The correlation coefficient between post PCI Simpson’s and GLS, $r = -0.19092$

Significance Based On Population Correlation Co Efficient (P Value):
 P value for relation between pre-PCI Simpson’s and GLS is 5.04×10^{-76}
 P value for relation between post PCI Simpson’s and GLS is 1.07×10^{-76}

P value is less than significance level ($\alpha = 0.05$)

Discussion:

This research explored the impact of PCI on LV systolic function by comparing 2D speckle tracking- GL strain method & Simpsons biplane method. Pre & Post PCI LV systolic function were assessed using both the parameters, both GLS and Simpsons method shows improvement in which we proved GLS is more accurate than Simpsons biplane method. A novel echocardiography method for assessing myocardial function is evaluated using 2DSTE. Over the past 15 years, strain imaging has developed in tandem with advancements in ultrasonography technology, including improved image quality resolution, more accurate imaging, more efficient acquisition, and easier-to-use post processing software. This evolution has coincided with the growing body of studies showing that strain is a useful tool for identifying early subclinical myocardial disease outside of the traditional EF & Simpsons method(15). GLS is impacted by the pressure-volume properties of the LV, myocyte contraction, and the tissue composition (myocardial fibrosis). Consequently, GLS is a perfect indicator of LV myocardial dysfunction in individuals. The most sensitive strain measure in the presence of myocardial illness is GLS since it is primarily controlled by the sub-endocardial layer. The subepicardial and middle cardiac layers aid in LVEF determination and are involved in twist and circumferential mechanics(16). GLS has also been suggested as one of the new factors in the assessment of LVSF in the most recent ASE/EACVI guidelines for chamber quantification(17). The automatic system tracks the complete myocardial wall as well as three concentric lines on the endocardial border, mid-myocardial layer, and epicardial border. Every myocardial region is included throughout the cardiac cycle, the tracking algorithm tracks the endocardium from the single frame(18). It has been found to be a more accurate prognostic indicator than LVEF since it is comparatively independent of angle dependency and may indicate preclinical LV systolic failure(19,20). LVEF will remain a cornerstone of LV function assessment, GLS is more attractive and has better inter-observer variability than Simpsons Biplane

method(21). Our results are similar to the study of Sigve Karlsen ., who addressed GLS is a more reproducible method for evaluation of LV function (22), Medvedkovsky et al. who addressed GLS assessment by a semiautomated technique is feasible, fast, and provides quantitative information (23) and of Negishi et al.(24), Kashif Kalam ., who addressed that GLS is superior to LVEF method(25), Sjøli, B ., who also addressed GL strain demonstrates better interobserver reproducibility (26).

The mean value of Pre PCI-Simpson's and GLS are 43.15 and -9.483 respectively.

The mean value of Post PCI Simpson's and GLS are 49.42 and -11.091 respectively.

The correlation between Pre PCI-Simpson's and GLS is -0.83181

The correlation between Post PCI Simpson's and GLS is -0.19092

Which is a Moderately Negative correlation.

The significance of correlation using P value for Pre PCI Simpsons & GLS is 5.04×10^{-76}

The significance of correlation using P value for Post PCI Simpsons & GLS is 1.07×10^{-76}

Since $P < 0.05$ the correlation between Pre and Post PCI Simpson's and GLS is significant.

In our prospective observational study both Simpsons & GLS shows difference in variation. In pre & post PCI Simpsons and GLS the LV systolic function has improved, also when compared with pre-PCI Simpsons & GLS and post PCI Simpsons & GLS, the statistical variation is noted. Where GLS shows accurate results when compared to Simpsons biplane method.

Conclusion:

An essential tool for evaluating LV systolic function is echocardiography. The study found that patient's LV function improved after revascularization. Our research has shown that GLS is a more accurate indicator of LV myocardial ischemia and function than Simpson's biplane method.

Thus, the aim is to prove that LVSF can be accurately assessed using the Global Longitudinal Strain Method. In patients who have undergone percutaneous coronary intervention, GLS offers additional predictive information over Simpson's

biplane method. Following PCI, LV function was significantly improved in both GLS and Simpson's. In GLS, the improvement is greater in magnitude.

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