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To determine how beneficial global longitudinal strain (GLS) at rest is for detecting substantial coronary artery disease

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Abstract:
The top cause of death around the world, cardiovascular disease is also the primary cause of death in India. In 2016, India anticipates a total of 62.5 million premature deaths due to cardiovascular disease. **Aim:** This research was conducted with the goals of (1) determining whether resting global longitudinal strain (GLS) correlates with angiographic severity in patients with coronary artery disease by using the GENSINI and SYNTAX scores; (2) evaluating the validity of using GLS to diagnose severe coronary artery disease; and (3) determining whether or not GLS can be used to diagnose severe coronary artery disease. It was anticipated that the study's findings would provide solutions to both problems. **Materials & methods:** To participate in the experiment, participants were required to either have coronary artery disease or a clinically comparable diagnosis. The study was conducted at the SCB Medical College and Hospital in Cuttack, which served as the location. Patients who had unstable angina, chronic stable angina, or myocardial infarction that did not involve ST-elevation were recruited to take part in the trial if they satisfied the inclusion criteria. The observational research method, known as cross-sectional research, was used for this study. One hundred and ten patients were evaluated for coronary artery disease as a potential diagnosis. Patients eligible to take part in the trial, defined as those who satisfied the inclusion criteria and made an appointment with a cardiologist at SCB Medical College and Hospital between August 2020 and December 2021, were allowed to do so.
Conclusion: When evaluated during rest using 2D speckle tracking echocardiography, GLS reliably predicts the prevalence, severity, and degree of CAD. This test has a very high sensitivity and specificity. GLS has an early detection rate of 88.89% specificity and 84.62% sensitivity for severe CAD. The well-known SYNTAX and GENSINI scores show a linear but negative relationship between CAD complexity and GLS. 2-D-STE can improve echocardiography for the diagnosis of CAD by identifying high-risk individuals and providing the treating physician with more information. When the pretest chance of coronary artery disease is low, strain imaging can reveal significant illness in the heart's arteries. This is especially true during the entirety of the examination.

Keywords: Cardiovascular Disease; Coronary Artery Disease; Treadmill Test; Acute Coronary Syndrome; Single Vessel Disease; Double Vessel Disease; Triple Vessel Disease; ST-Segment Elevation Myocardial Infarction.

INTRODUCTION:

In India, as in the rest of the globe, cardiovascular disease (also known as CVD) is a leading cause of mortality. It is estimated that 62.5 million years of life have been cut short in India as a direct result of the early deaths caused by cardiovascular disease [1,2]. It is believed that ischaemic heart disease and stroke are responsible for between 15 and 20 percent of all fatalities that occur in India. [1,2]. Compared with other countries, India is predicted to have the most tremendous CVD burden by 2020. The WHO-PREMISE study results [3,4] showed that India had the highest percentage of patients under 50 with coronary heart disease (22.6% of men and 3% of women). The sickness strikes at a startlingly high incidence, with an approximate frequency of 11% in urban areas and 7% in rural areas, according to several research carried out in India [3, 4].

Imaging and other provocative tests are becoming increasingly popular. However, individuals with NSTEMI, UA, and CSA still have trouble evaluating whether or not they have severe coronary artery disease. Even though imaging is becoming more widespread. 5, 6] More than half of patients who undergo coronary angiography are found to have normal CAD, often known as non-obstructive CAD. The exercise stress test, often known as the "treadmill test" (TMT), is the non-invasive diagnostic technique used for the longest time to diagnose myocardial ischemia. Despite its extensive use to identify individuals for coronary angiography, the shortcomings in this method are highlighted in the stable coronary artery disease recommendations [5]. The researchers discovered a connection between severe CAD and the dysfunction of the LV. The left ventricle (LV) ejection fraction is frequently expected in the disease's early stages. It is indispensable to develop a more sensitive index for the early detection of LV dysfunction [5, 6].

There is a significant variation between and among observers when using this echocardiography method [7], even though it is generally acknowledged as a reliable approach to detecting ventricular wall motion and regional myocardial function. This suggests that it cannot detect radial displacement and deformation, as well as myocardial shortening and twisting [8]. Additionally, this indicates that it is unable to detect radial displacement. Myocardial shortening is also not something that can be observed.

In recent years, velocity, displacement, and deformation imaging, also known as strain and strain-rate imaging, have become more popular methods for producing an echocardiographic heart function evaluation that is more comprehensive and reliable. [9]. Imaging techniques such as deformation imaging, displacement imaging, and velocity imaging are some examples of the available imaging techniques. In two-dimensional grayscale echocardiography, also known as speckle-tracking echocardiography, the strain placed on the heart may be accurately evaluated with this method. It has been demonstrated that this method is sensitive to abnormalities brought on by ischemia and necrosis [10], making it possible to conduct a complete assessment of regional and global cardiac function.

Speckle tracking strain echocardiography allows for the possibility of quantitative localized and global assessments of the left ventricle. This method has been helpful as an adjunct to wall motion analysis [4] for the past ten years. The heart's muscles are stretched in each of the three dimensions. Both the circumferential axis and the longitudinal axis of the heart are responsible for the expansion and contraction of the heart [6]. On the other hand, traveling in a radial direction leads it to grow flatter and slimmer. In light of this, it seems likely that the strain will adopt either a circular, radial, or longitudinal direction. One strain measurement is known as the longitudinal strain, and this is the only kind we have taken [5]. This is because when measuring pressure, the findings obtained from the longitudinal strain give the highest level of reliability.

The signs of coronary artery disease include acute coronary syndrome (ACS), silent ischemia, persistent angina pectoris, and death [11]. An unstable angina, a myocardial infarction without ST-segment elevation, or a myocardial infarction with ST-segment elevation can all be symptoms of acute coronary syndrome (ACS). Elevation of the ST segment is the most common symptom of a complete coronary blockage, which mandates urgent pharmacological reperfusion [12]. Patients suffering from NSTEMI, UA, and CSA presented a greater variety of symptoms [12]. Coronary occlusion and severe stenosis can sometimes warrant therapy with coronary angiography and revascularization; however, this is not always the case [13]. Therefore, angiography of the coronary arteries and revascularization are not always required. Selecting patients for coronary angiography and revascularization treatment with extreme caution can help reduce complications and expenses.

The severity of CAD may be evaluated using a few different methods. In clinical practice, vessel scoring, often frequently referred to as the stenosed vessel count [10], is the diagnostic approach that is used the most frequently. As a result, coronary artery disease may be segmented into four subtypes: left central disease, single vessel disease (also known as SVD), double vessel disease (also known as DVD), and triple vessel disease. The left major coronary artery is typically affected in cases of coronary artery disease. Since coronary angiography was first performed, other approaches to determining the severity of coronary artery disease have been devised [12]. These examinations determined The severity of CAD in an exact and objective manner. With a correlation of 0.90 and a p-value of 0.001, the GENSINI score [13] was shown to have the most substantial connection with the intracoronary plaque that IVUS detected.

This research was conducted with the goals of (1) determining whether resting global longitudinal strain (GLS) correlates with angiographic severity in patients with coronary artery disease by using the GENSINI and SYNTAX scores; (2) evaluating the validity of using GLS to diagnose severe coronary artery disease; and (3) determining whether or not GLS can be used to diagnose severe coronary artery disease. The study findings would be submitted to the Journal of the American College of Cardiology for publication.

MATERIALS & METHODS:

To be eligible to participate, patients must either have coronary artery disease or a clinical diagnosis that is clinically similar. The research was carried out at the SCB Medical College and Hospital, which is located in Cuttack. Patients who suffered from unstable angina, chronic stable angina, or myocardial infarction that did not involve ST elevation were enrolled in the trial if they were deemed eligible. The observational research method, known as cross-sectional research, was utilized for this study. One hundred and ten patients were evaluated for coronary artery disease. Patients who satisfied the inclusion criteria and were seen by a cardiologist at SCB Medical College and Hospital between August 2020 and December 2021 were eligible to participate in the trial.

Participants are required to be at least 18 years old and to have either chronic stable angina, unstable angina, or a myocardial infarction that did not involve an ST elevation. STE can quantify myocardial strain, but the patient has to be willing to undergo coronary angiography and can do so. In addition, the patient's echo window needs to be rather broad.

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Patients who had decompensated heart failure, myocardial infarction, CABG, were pregnant or were nursing were not allowed to participate in this experiment. Patients who had previously suffered a myocardial infarction were not eligible. On 2D echocardiography, patients who have significant valvular or congenital heart disease, cardiomyopathies such as DCM, HCM, and RCM, atrial fibrillation, or premature ventricular complexes are more likely to display regional wall motion abnormalities. This abnormality also frequently occurs in cardiomyopathies such as DCM, HCM, and RCM.

Patients suspected of having coronary artery disease who sought treatment at the cardiology departments of SCBMCH and Cuttack were required to provide written consent before receiving therapy. After collecting participants' demographic information at the beginning of the study, individuals underwent screening that included a history and physical examination, electrocardiogram, standard blood tests, cardiac markers, and echocardiography to assess their eligibility for the research. Patients consistently go through biochemical investigations. In addition to a routine and microscopy-active sediment urine examination, a thorough hemogram, urea, creatinine, and viral indicators such as HBV, HCV, and HIV are analyzed during this test. A microscopy-active sediment urine test is also included in the package. Those who were considered smokers were those who had smoked cigarettes, bidis, or cigars for more than four weeks and those who had quit smoking within the last year. To obtain an accurate reading of the patient's blood pressure, the patient was instructed to assume the supine position and have their left arm linked to the sphygmomanometer. The patient was provided with an appropriate cuff. They were diagnosed with hypertension if either their systolic or diastolic blood pressure was more than 140 or 90 mmHg or if they were receiving hypertension medication. If the fasting plasma glucose (FPG) was over 126 mg/dl and the post-prandial plasma glucose (PPG) was over 200 mg/dl. It was determined that the patient had diabetes. This was the case regardless of whether or not they were taking diabetes medication or had a history of diabetes in their family. In the past, dyslipidemia was diagnosed by measuring triglycerides (TG) and cholesterol levels that were below 200 mg/dl. People who have dyslipidemia, those who are taking medication for dyslipidemia, or those who have an elevated LDL-C level of more than 150 mg/dl or an HDL-C level of less than 40 mg/dl in males and 50 mg/dl in women. People diagnosed with dyslipidemia and those who are taking medication for dyslipidemia.

The subsequent procedure was a 2D-speckled tracking echo (STE) performed with GE Healthcare's Vivid 8 ECHO. Any of the three standard planes, 2c, 4c, or 3c, can be utilized to produce a grayscale, two-dimensional echo image. Wall lengthening and shortening are both monitored by the AFI algorithm, which does so in three different longitudinal imaging planes (apical long, two chambers, and four chambers). Elongated apical planes that contain two to four partitions. After that, it examines each segment and produces a global peak systolic value of LV as a bull's-eye summary by the standard paradigm of 17 sections. In this way, the reliability of the findings is ensured.

According to Poiseuille's law, the influence on flow rises by a factor of two for each of the three phases of the growth of the Gensini score (a reduction in diameter of 25–50%, 75–90%, and 99–100%, respectively). As a direct result, the lesions observed in this succession were given severity ratings of 1, 2, 4, 8, 16, and 32, respectively. A region-multiplying factor is a factor that may be used to describe the quantity of myocardium that is supplied by a coronary segment.

As seen in the following table, the severity ratings of the collaterals located to the right of the supporting element have been modified. The degree of illness in the collateral artery harms the adjustment.

To get the Gensini Score, multiply the severity score by the lateral adjustment factor and then multiply that result by the segment location multiplicative factor.

If We Were to Judge SYNTAX by its Cover: When the ACEF score is added to the SYNTAX score, the resulting number is the clinical SYNTAX score. The logistic model was initially additive, but it has since evolved to give a framework for tailored risk assessment that is richer in nuances. Patients who have significant coronary artery disease (CAD) or left main (LM) coronary artery disease can have their long-term mortality risk predicted by the SYNTAX II score. This score takes into account both morphological and clinical factors. This makes the prognosis look better. Research comparing coronary artery bypass grafting with percutaneous coronary intervention showed that the SYNTAX score was superior to the SYNTAX score. The DELTA registry validated drug-eluting stent therapy to treat the left central coronary artery disease.

The following is a rundown of how the SYNTAX scoring system operates: possessing and keeping hold of How many different tissues are compromised by each Lesion (area of damage). The following are some of the distinguishing characteristics of obscuration complete: The following considerations need to be made if the blockage has been present for more than three months: i. the total number of segments that have been damaged; ii. the blunt stump; iv. the bridging collaterals; v. the first segment that can be seen by either antegrade or retrograde filling following the occlusion; and vi. the involvement of side branches. There were three key distinctions between them: Number of damaged segments, Type of segment, Angle between distal main vessel and side branch that is less than or equal to 700 degrees, and Lesion at the aorto-ostial junction, significant tortuosity, length more prominent than 20 mm, substantial calcification, thrombus, and widespread illness with involvement of minor vessels. How many parts are affected by diffuse disease and have little dishes? i. The SYNTAX score was produced by software that gives the user a series of questions to respond to in a specific sequence. These questions are presented to the user in a particular order.

Statistical analysis:

The information was brought into Excel and then transferred to SPSS 20 for analysis. Percentages were used to represent categorical data, whereas mean SD or median (interquartile range) were used to report continuous variables. T-test and ANOVA tests compared the means of groups with and without stenosis of 70%, with a significance level of p0.05 indicating statistical significance.

RESULT:

Table 1: Distribution of the study subjects based on the age group

Age group	Frequency	Percentage
<30	2	1.82
31 to 40	4	3.64
41 to 50	24	21.82
51 to 60	39	35.45
>60	41	37.27
Total	110	100.00

The patients who took part in the trial were older than eighteen. Table 1 shows the patients' mean age was 56.81 ± 9.58 years. The study population consisted mainly of participants over 60, representing 37.27% of the total. Next in line were subjects between the ages of 51 and 60, totaling 35.45% of the research population. Merely 5.46% of the participants were under 40 years old. There were 110 patients, with 13.64% female and 86.36% male. The majority of patients (50%), then diabetes (42.73%), had a history of hypertension. Most patients (about 51%) had CSA, and roughly 42% had NSTEMI (Table 2).

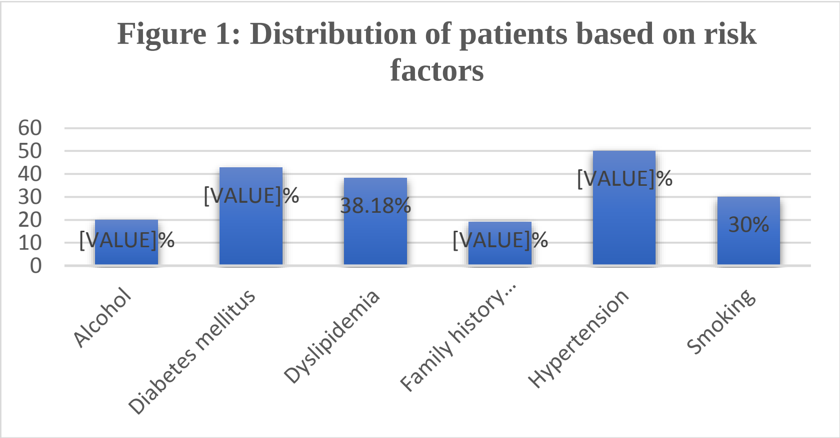

Table 2: Distribution of the patients based on diagnosis

Diagnosis	Frequency	Percentage
CSA	56	50.91
NSTEMI	46	41.82
UA	8	7.27
Total	110	100.00

Regarding substantial CAD, involvement in a single vessel was more prevalent in the study group. In contrast, illness of the left major artery was found to be the least common (Figures 1 & 2). Because there was no evidence of an isolated case of LM illness, individuals who had LM in addition to either DVD or TVD were classified as having either DVD or TVD for this study. The LAD was the artery most frequently afflicted by single-vessel disease. In contrast, the RCA was the vessel that was damaged the least often. The left anterior descending (LAD) and the left circumflex artery (LCX) were the most common combinations of highways to be affected by a double vascular ailment. Both of these arteries are located on the left side of the body.

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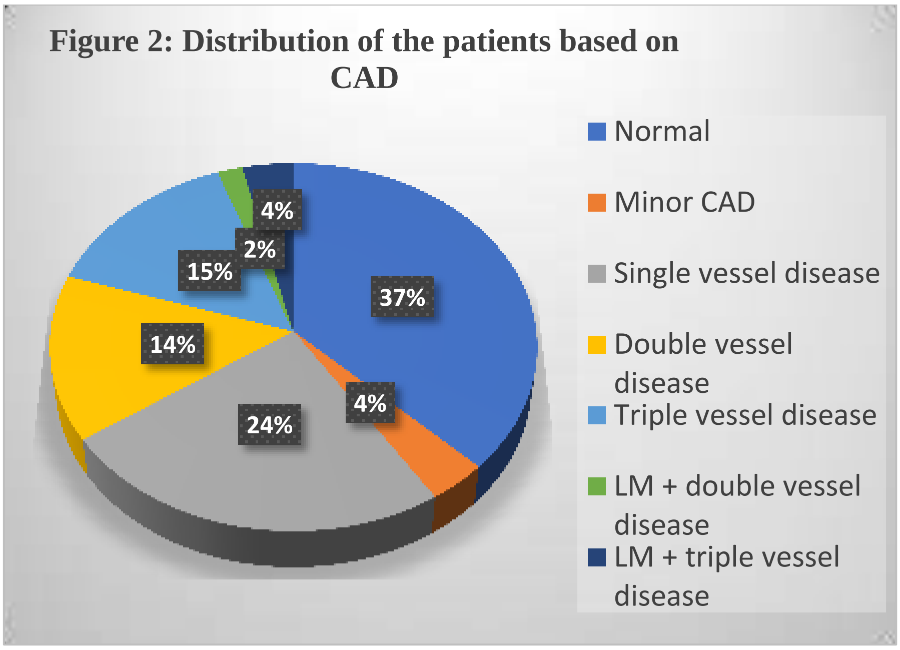

Figure 2: Distribution of the patients based on CAD

Figure 3: Significant vessel affected among the subjects diagnosed to have single vessel disease

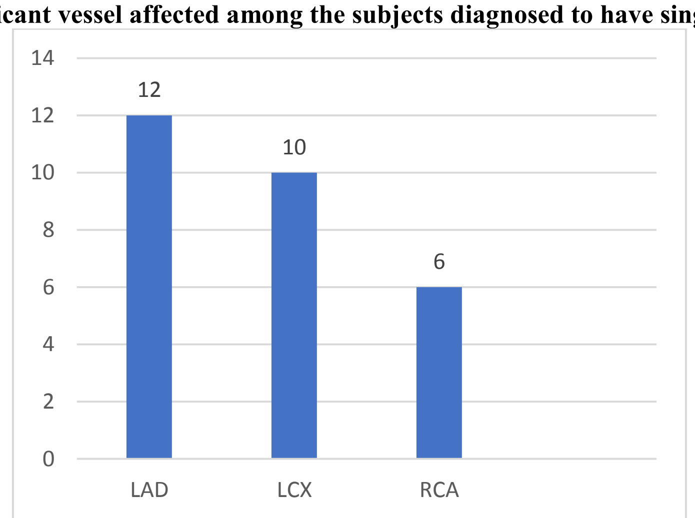

Figure 3 shows that the LAD was the artery affected by single-vessel illness the most frequently in these patients. The LAD and the LCX combination was the most prevalent combination of highways for patients with double vascular disease (figure 4).

Figure 4: Significant vessel affected among the study subjects with a double plate and triple vessel disease in decreasing order of frequency.

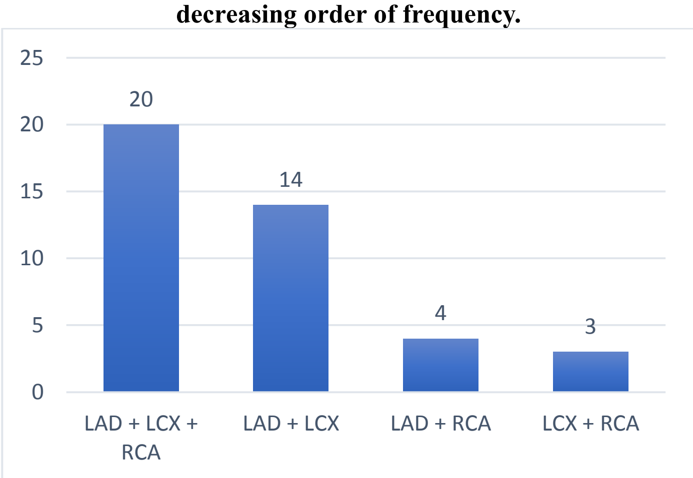

Table 3: Distribution of the patients based on SYNTAX score

Syntax score*	Frequency	Percentage
<22	99	90.00
22 to 32	9	8.18
>32	2	1.82
Total	110	100.00

Table 4: Distribution of patients based on GENSINI score

GENSINI score*	Frequency	Percentage
<8	47	42.73
>8	63	57.27
Total	110	100.00

*Median value has been used

Table 5: Association of severity of CAD and various factors

Factors	Normal		Minor CAD		Single vessel disease		Double vessel disease		Triple vessel disease		P value
	Mean/ Frequency	SD/ %	Mean/ Frequency	SD/ %	Mean/ Frequency	SD/ %	Mean/ Frequency	SD/ %	Mean/ Frequency	SD/ %	
Age	56.50	7.77	51.00	11.58	55.80	10.34	59.11	9.98	57.20	8.55	0.4968
Gender											
Female	1	5.56	2	50.00	8	19.51	3	11.11	1	5.00	0.0878
Male	17	94.44	2	50.00	33	80.49	24	88.89	19	95.00	
Risk factors											
Alcohol	1	5.56	1	25.00	9	21.95	9	33.33	2	10.00	0.1493
Diabetes mellitus	10	55.56	1	25.00	15	36.59	14	51.85	7	35.00	0.4391
Dyslipidaemia	7	38.89	3	75.00	13	31.71	5	18.52	14	70.00	0.0030
Family history of CAD	2	11.11	1	25.00	9	21.95	4	14.81	5	25.00	0.7686
Hypertension	10	55.56	1	25.00	19	46.34	13	48.15	12	60.00	0.6846
Smoking	7	38.89	1	25.00	14	34.15	7	25.93	4	20.00	0.6942
ECHO parameters											
IVS	11.53	1.56	13.50	3.79	11.32	2.14	11.37	1.64	10.93	1.36	0.1794
LVEDD	44.28	2.99	42.25	5.32	44.02	3.50	43.26	3.69	42.90	3.61	0.5869
LVESD	29.61	3.42	28.75	0.96	29.61	3.29	30.48	3.12	28.85	3.34	0.5066
PW	11.36	1.43	12.00	1.15	11.12	1.58	11.22	1.57	10.98	1.26	0.7479
FS	33.83	4.81	31.75	4.92	33.37	5.26	31.33	3.89	31.55	3.17	0.2218

Concerning demographic characteristics (mean age, gender), risk factors, and different ECHO parameters, there was not a significant difference between the normal coronaries, minor CAD, SVD, DVD, and TVD groups because the p-value is >0.05 (Table 5 & 6) except for hyperlipidemia, which was much more prevalent in the groups who had SVD and TVD as opposed to the groups that had normal coronaries and minimal CAD. Therefore, based on the characteristics of a standard

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ECHO, we are unable to categorize individuals as being at low risk or high risk for substantial obstructive coronary artery disease.

Table 6: Association of severity of CAD and mean GLS values

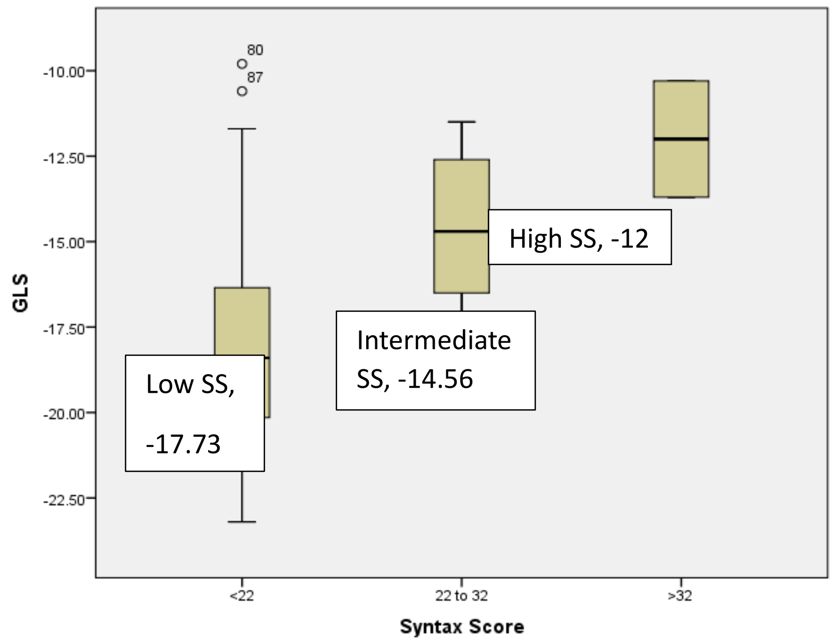
CAD	GLS		GENSINI Score		SYNTAX Score	
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**
Normal	-20.88	1.80	0.60	3.14	0.22	1.41
Minor CAD	-19.91	1.79	1.63	1.11	0.50	1.00
Single vessel disease	-16.49	7.02	18.81	17.17	4.70	3.84
Double vessel disease	-15.16	2.05	46.75	12.52	16.25	4.64
Triple vessel disease	-14.13	2.56	65.09	20.31	16.81	6.86
P value	<0.001		<0.001		<0.001	

The table above links mean GLS and coronary artery disease severity. With coronary artery disease, GLS dropped considerably (p 0.001) (Table 6).

With 84.62% sensitivity, the optimal GLS cutoff value for severe coronary artery disease was – 17.69 + 0.8. Specificity was 88.89%, with a remarkable 90% positive predictive value. The optimal GLS cutoff value for significant single-vessel conditions was -18.44±1.07, with 84.44% sensitivity and 63.08% specificity. The optimal GLS cutoff value for severe double vessel disease was -17.35±0.8, with 66.3% specificity and 94.44% sensitivity. An appropriate GLS cutoff value of -15.33±0.45 was identified with a sensitivity of 55% and specificity of 86.67% for severe triple vessel disease. The SYNTAX score shows that the current study's mean GLS values decrease with coronary artery disease severity. Table 6 shows this association for each SYNTAX score group.

Patients with low SYNTAX scores (<22) had a significantly lower mean GLS value of -17.73+4.60, while those with intermediate scores (22-32) had -14.56+2.29, and those with high scores (>32) had -12+2.40. The Spearman's rank correlation coefficient test showed a linear inverse relationship between GLS and SYNTAX scores ($p < 0.001$). This indicates that SYNTAX scores grow when GLS values fall. GLS/GENSINI scores The Spearman's rank correlation coefficient test showed a linear inverse relationship between the variables ($p < 0.001$). Thus, GENSINI scores climb as GLS values fall.

Figure 5: Correlation between GLS and SYNTAX score groups as Low SS (<22), Intermediate SS (22-32), and High SS (>32)



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DISCUSSION:

The presence of CAD has to be identified well in advance of severe outcomes such as acute coronary syndrome or sudden cardiac death, both of which can result in significant morbidity and mortality. In individuals requiring invasive treatment, normal left ventricular systolic function raises the threshold for investigation. However, there are still questions about the screening approach that is both the most appropriate and cost-effective, as well as the effectiveness of CAD screening. Echocardiography is one of the imaging techniques for the heart that is used most frequently on individuals who have heart conditions. Because most patients with suspected NSTEMI, UA, or CSA show normal wall motion while at rest, a traditional echocardiogram does not help diagnose and risk classifying these individuals. This is the case unless there is a history of a previous myocardial infarction or stroke. As a result, it would be beneficial to have a resting module that could differentiate between severe and moderate CAD episodes.[4].

Global longitudinal strain, measured by 2-D speckle-tracking echocardiography (2-D STE) at rest, is a sensitive metric for identifying significant CAD [15]. Thus, in this study, we looked at the GLPSS's predictive ability for the presence, severity, and extent of CAD in people diagnosed with CAD (NSTEMI/UA/CSA) and how well it corresponded with angiographic severity ratings. The GENSINI and SYNTAX scores [16]. Subjects over 60 comprised 37.27% of the research population, while issues between 51 and 60 included 35.45%. These subjects made up the bulk of the study population. The patient's average age was 56.81 ± 9.58 years. In that order, the mean age in studies [16–18] was 53.86 + 8.99 years, 55 + 10.6 years, and 62 ± 11 years. The mean age of a different research by Gopinath *et al*. [19] in Kerala, India, was 56.07+ 10.7 years. Madhavan and colleagues carried out a study. The average age of a patient in India is 55 [20]. The research population's mean age in our investigation was similar to previous analyses.

13.64% of the participants in the research were female, while 86.36% of the participants were male. In a previous study [16], 44.4% of participants were women, and 55.6% were men. In studies [16–18], 31% of participants were women, and 69% of participants were men. Men comprised 35% of the subjects in the Sorensen *et al*.42 study, while women comprised 65%. Consequently, there were differences in the proportion of males and women in each study, but this had no impact on the results.

Among the 110 research participants, hypertension was shown to be the most common risk factor (50%); diabetes (42.73%) followed closely, followed by dyslipidemia (38.18%); smoking (30%), alcohol use (20%), and a family history of coronary artery disease (19.09). However, the majority of study subjects had several risk factors. Numerous other studies have shown that the two most common risk factors for dyslipidemia are diabetes and hypertension. [16, 20, 21].

Out of 110 research participants, NSTEMI (41.82%) was the most common diagnosis, followed by CSA (50.91%) [21]. With a prevalence of 7.27%, UA was the most minor common diagnosis. GLS was investigated in patients with NSTEMI and stable ischemic heart disease [16] in a few trials exclusive to one research group [17]. Two studies on clinical CAD patients (UA/NSTEMI/TMT positive) and female patients with effort angina who tested positive for TMT were conducted by Indian researchers [19] and [20]. Ismail *et al*. included a research population of ACS-ST-increased MI. [22].

In this study, 110 patients had normal coronaries in 37.27%, mild CAD in 3.64%, SVD in 24.55%, DVD and TVD in 14.55%, LM + DVD in 1.82%, and LM + TVD in 3.64% of cases. The most typical coronary angiography (CAD) presentation is SVD. In research by [16], SVD, DVD, TVD, LM, and 15.5% of the study group had normal coronaries, 35% had SVD, and 2.5% had LM. Like the current study, SVD was the most prevalent involvement in CAG. In research by [23], which included 43% of the study group with SVD, 26% with DVD, 31% with TVD, and 11% with LM illness, similar findings were noted. 33.33% of participants in different research conducted in India by [19] had normal coronaries, 13.95% had moderate CAD, 18.6% had SVD, 21.7% had DVD, 8.53% had TVD, and only 1.55% had involvement of the LM vessels. The most popular presentation on CAG is on DVD.

In our analysis, the two arteries most commonly impacted by single-vessel illness were the RCA (5.45%) and the LAD (10.91%). The most typical vessel combinations afflicted by double-vessel disorders were LAD and LCX. In 45.45% of the research participants, the LAD was the most impacted conduit. The most prevalent artery with substantial stenosis in research by [24] was the LAD (0.5%), followed by the RCA (58%) and the LCX (48%). Significant LAD involvement was most frequently observed in 72%, LCx in 56%, and RCA in 60% of the research group, according to a study by [23].

This study examined 110 individuals with CSA/NSTEMI/UA who had no issues with regional wall motion. Coronary angiography and 2D-STE GLS were administered to these patients. With mean GLS values of -20±1.79 (not significant CAD) vs. -16.1±2.68 (significant CAD), $p < 0.001$, those with considerable stenosis (>70%) on coronary angiography had a considerably lower GLS value than those without substantial CAD (<70% stenosis).

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Studies have examined rest GLS during invasive angiography to determine if a patient has obstructive CAD. The GLS was much lower in people with severe CAD than those without. This matched our findings. Biering-Sørensen *et al*. [23] studied 296 people with suspected acute coronary syndrome. High-CAD individuals had considerably lower GLS values (mean = -17.3± 2.6 vs. -18.9± 2.6; p <0.0001) compared to those with common CAD (24, 25).

Gopinath *et al*. studied 129 cases. Obstructive CAD patients showed a lower global strain value (18.37 ± 4.13) compared to those without CAD (-21.18 ± 3.81; p <0.01). In 86 people with myocardial infarctions without ST elevation, Al-Amin *et al*. [17] showed that those with severe coronary artery disease had a considerably lower GLS value (-13.5 + 3.4 vs. -19.01 + 2.32).

In the current investigation, GLS gradually decreased as stenotic coronary arteries, a measure of CAD severity, increased. Patients with single vessel disease reported a GLS value of -16.49±7.02, whereas those with double and triple vascular illnesses had -15.16±2.05 and -14.13±2.56, respectively. **p < 0.001. GLS reduction increases multivessel disease risk.

In the research, -18.44±1.07 was the optimal GLS cutoff value for substantial single-vessel disease, with 84.44% sensitivity and 63.08% specificity. The optimum GLS cutoff value for severe double vessel disease was -17.35±0.8, with 94.44% sensitivity and 66.3% specificity. The best GLS cutoff value for severe triple vessel disease was -15.33±0.45, with 55% sensitivity and 86.67% specificity. Moustafa *et al*. [16] reported 90%, 95.1%, 99%, 88.9%, 63%, and 72.2% sensitivity and specificity for SVD, DVD, and TVD at the same cutoff value. The current study found negative predictive discounts of 85.42%, 98.39%, and 89.66% for SVD, DVD, and TVD. Few research [16, 17] have examined GLS's negative predictive value.

Gaibazzi *et al*. [26] observed that vendor-independent GLS predicted substantial CAD and stress-echo wall motion analysis. Patients with significant CAD had a significantly lower rest GLS (-19+ 2.4 vs. -22.7 + 2.4, P = 0.001). Research indicates that GLS </> -20.7 may accurately predict CAD blockage (>50%) with 84.9% specificity and 81.6% sensitivity. 296 stable angina pectoris patients were studied by Biering-Soerensen *et al*. [23]. Patients with severe CAD exhibited substantially lower GLS mean values (GLS) compared to those without CAD (GLS = -17.1 ± 2.5 vs. -18.8 ± 2.6, p < 0.000). GLS >/< -18.4% can indicate substantial blockage (>70%) of CAD with 74% sensitivity and 58% specificity. 42 Suresh Madhavan *et al*. recruited 1,000 female angina patients. At least one coronary artery had a severe coronary lesion of >70% in individuals with an average GLS score of 15.56%. The optimal GLS score for predicting painful coronary lesions was −17.5. GLS by 2DSTE indicates substantial coronary lesions in female exertion angina patients with 94% sensitivity and 76% specificity, which is highly connected with CAD angiographic severity. According to Gopinath *et al*.'s [19] enrollment of 129 suspected CAD patients, peak longitudinal strain imaging by speckle tracking is a sensitive test (90.69% to 97.14%) with a high negative predictive value (75% to 92.3%) for identifying obstructive coronary artery lesions on coronary angiography. Smedsrud *et al*. examined 86 chronic chest pain patients [25]. GLS values appeared as follows: -17.9 ± 3.5 for CAD+ patients, -20.1/2.9 for CAD- patients. To predict substantial CAD (>50%), the GLS cutoff value was -17.4, with 51% sensitivity and 81% specificity.

In a study of 110 patients, GLS values were significantly lower in those with significant stenosis (>70%) on coronary angiography compared to those with non-significant stenosis (<70%) (mean values: -20.0±1.79 vs. -16.10±2.68, p < 0.001). With 84.62% sensitivity, specificity, and 90% positive predictive value, a GLS value >/< - 17.69 may suggest substantial CAD blockage. CAD severity can be assessed in different ways. The vascular score—the number of stenosed vessels—is commonly used in clinical practice. CAD includes LM, SVD, DVD, and TVD. Numerous scoring methods for CAD burden evaluation have been offered since coronary angiography. CAD was objectively and consistently measured using these scores.

When the SYNTAX score indicated more coronary artery disease, the mean GLS values declined considerably. A strong correlation existed in all SYNTAX score categories. The mean GLS for patients with low SYNTAX scores (less than 22) was -17.73+4.60, intermediate (22–32) was -14.56+2.29, and high (32+) was -12+2.40. GLS is inversely correlated with syntactic scores. Similar findings were found by Abdelrazek *et al*. [27]. Other studies have not shown a linear link between SYNTAX groups. Moustafa *et al*. [16] found a negative connection between GLPSS and syntactic score. This association was significant for high and intermediate syntax scores (p = 0.001) but not low syntax scores (p = 0.05). Patients with low SYNTAX scores showed substantial correlations (r = 0.580, p < 0.0001). However, those with intermediate-high scores (r = -0.033, p = NS) did not.

According to Vrettos *et al*. [28], there is a substantial inverse association between GLPSS and SS scores (r2 = 0.3869, P <0.001). The high-SS group showed no association (r2 = 0.0002, P = NS), whereas the low-SS group showed a weaker relationship (r2 = 0.1332, P <0.05) [28]. IVUS measurements of intracoronary plaque load corresponded most strongly (p < 0.001) with the GENSINI score, among other scores used to diagnose coronary artery disease. Many research have linked GLS and SYNTAX scores. Like Al-Amin *et al*. [17, 18], few studies have used the GENSINI score to measure 2D speckled myocardial strain for angiographic severity in NSTEMI. The association between GLS and GENSINI scores in coronary artery disease was also studied. The study found a linear inverse connection between GLS and GENSINI scores ($p < 0.001$). This implies that GENSINI scores rise as GLS values fall. Amin *et al*. found comparable results. [17].

The current research demonstrates that speckle-tracking echocardiographic strain imaging may be utilized in conjunction with clinical evaluation and conventional 2D echocardiography to improve the accuracy of coronary angiography in diagnosing obstructive coronary artery disease. The non-invasive, less expensive, and more expedient testing method for high-risk obstructive coronary artery disease is speckled tracking echocardiography. Patients who are severely obese, have trouble walking, or are unable to participate in an exercise stress test can quickly finish it. Speckled echocardiography was performed without the use of any drugs. Consequently, the examination may be performed as an outpatient operation that does not require any preparation. Speckled tracking echocardiography is an alternative, sensitive, and joyous method for distinguishing between mild and severe coronary artery disease (CAD) cases. With a high level of specificity and a positive predictive value, we may also be able to identify individuals suffering from multivessel disease who have an increased risk and may require immediate medical attention.

Even with average ECHO values at baseline, a 2D speckle tracking echocardiography can detect significant coronary artery stenosis without intrusive procedures. It is possible to utilize the pretest probability in conjunction with the TMT to select patients for CAG and risk stratification if the pretest probability is low.

CONCLUSION:

When 2D speckle-tracking echocardiography is used while the heart is at rest, CAD's existence, extent, and severity may be correctly predicted based on GLS measurements. GLS has an early 84.62% sensitivity and 88.89% specificity in detecting severe CAD. The widely-used SYNTAX and GENSINI scores revealed a linear but negative relationship between CAD complexity and GLS. To enhance echocardiography to see CAD, 2-D-STE can identify high-risk people and give the treating physician more information. When there is a low pretest likelihood, strain imaging is an excellent screening tool for severe coronary artery disease.

Conflict of interest:

There exists no conflict of interest among the present study authors.

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