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Outcomes of Electrocardiography using the standard criteria of Echocardiographic results for Left Ventricular Hypertrophy in the North Indian Population

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Abstract
Objective: The purpose of this study is to evaluate and contrast the diagnostic potency of two-dimensional echocardiography and electrocardiography (ECG) in a clinical situation.
Methodology: A sample of 108 people with a medical history and clinical profile were recruited to to evaluate the effectiveness of various electrocardiographic criteria in identifying left ventricular hypertrophy (LVH) in patients by using 3D echocardiography. The area-length approach, which involved using data derived from 3D echocardiographic imaging, was used to calculate the left ventricular mass. Calculating the difference between the left ventricular epicardial volume and the left ventricular endocardial volume will yield the left ventricular mass. The volume of the left ventricular myocardium is represented by the number 1.05. 1.05 g/mL is the myocardial density measurement.
Results: The results of the present investigation showed that all participants had hypertension and a significant proportion of them had coronary artery disease (CAD). It was found that among the various criteria used to diagnosis LVH, the ECG LVH Sokolow Lyon criteria could be utilized to identify a maximum of 52.8% of patients with LVH. The next method was the Cornell voltage CR criterion, which identified LVH in 38.9% of instances.
Conclusion: In conclusion, eectrocardiography (ECG) is found to be ineffective when assessing individuals for left ventricular hypertrophy (LVH) using widely accepted criteria. Instead, echocardiography is thought to be the best technique for evaluating LVH because it not only helps with diagnosis but also makes it possible to quantify left ventricular mass. In these cases, the additional information from the echocardiogram has a high prognostic value.

Keywords: Electrocardiographic, Echocardiographic, Left ventricular hypertrophy

INTRODUCTION:

Approximately 65.4% of people aged 60 and older have hypertension, which has been determined to be the cause of 6% of global mortality [1,2]. In India, this illness affects between 22% and 45% of men and between 16% and 38% of women [3]. Left ventricular hypertrophy (LVH), a specific risk factor for the prediction of acute coronary syndrome, stroke, sudden cardiac death, or heart failure, is usually brought on by persistent hypertension [4]. Although other cardiovascular conditions can potentially cause left ventricular hypertrophy (LVH), this study only considers LVH brought on by hypertension. The high prevalence of hypertension in our country, which considerably increases the burden of disease overall, is what led to this decision. Additionally, the main goal of this study is to evaluate hypertensive patients only, excluding those with additional heart diseases.

The left ventricular hypertrophy (LVH) can be evaluated using simple and well-defined criteria utilizing the electrocardiogram (ECG), which is easily available and reasonably priced. When compared to more specialized methods like echocardiography, magnetic resonance imaging, and autopsy investigations, the efficacy of this procedure is regularly called into question [5]. However, even though two-dimensional echocardiography is frequently regarded as the best tool for determining left ventricular hypertrophy (LVH), its efficacy is much inferior to that of more sophisticated imaging methods [4-5]. Additionally, in order to acquire echocardiographic facilities, it is necessary to develop the proper infrastructure and have qualified staff on hand. It is extremely difficult to undertake echocardiographic examinations at the most basic level of healthcare delivery due to the lack of financial resources and human capital in the medical sector, especially in rural primary health facilities. Therefore, it is essential to look at the potential value of electrocardiography (ECG) as a screening tool for left ventricular hypertrophy (LVH) in rural and urban settings, especially in situations where echocardiography is expensive and only used for screening [7]. If so, it can be effectively used in rural primary health facilities to diagnose left ventricular hypertrophy (LVH). This will ensure that patients who are more deserving of the facilities can access them and lessen the pressure on higher centers, which are already overburdened [8].

In fact, compared to two-dimensional echocardiography, alternative imaging modalities such as three-dimensional echocardiography and cardiac magnetic resonance imaging offer higher capabilities for evaluating left ventricular mass index. When it comes to diagnosing left ventricular hypertrophy (LVH), advanced imaging techniques offer enhanced sensitivity, specificity, and diagnostic accuracy. However, compared to the commonly used and established gold standard technique of two-dimensional echocardiography, these procedures are characterized by a large investment of time and

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financial resources, leading to their restricted adoption. [6-7] In fact, even in tertiary healthcare centers, the use of these advanced modalities is sparse. They are also impracticable for use as left ventricular hypertrophy screening tools due to their high cost [8]. Therefore, the purpose of this study is to evaluate and contrast the diagnostic potency of two-dimensional echocardiography and electrocardiography (ECG) in a clinical situation.

METHODOLOGY:

The current inquiry was carried out within the Cardiology Department. A sample of 108 people with a medical history and clinical profile that point to the existence of comorbid conditions such hypertension, diabetes mellitus, coronary artery disease, chronic renal disease, and peripheral vascular disease were included in the current investigation. These concomitant conditions could exacerbate the onset of left ventricular hypertrophy.

The gold standard diagnostic technique for LVH was 3D echocardiography, which was used in the study to evaluate the effectiveness of various electrocardiographic criteria in identifying left ventricular hypertrophy (LVH) in patients. Patients with bundle branch blocks, acute coronary syndrome and ischemic heart disease, moderate to severe aortic stenosis, hypertrophic cardiomyopathy (HCM), structural abnormalities of the chest wall (such as kyphosis or scoliosis), and chronic obstructive pulmonary disease were not included in the study. Patients who had Wolff-Parkinson-White syndrome, atrial fibrillation or atrial flutter, or who were using digitalis or an antiarrhythmic medication were also excluded from the study.

Participants received a detailed explanation of the study methodology, and their written informed permission was obtained. The Institutional Ethical Committee gave approval to the study. The patients had a complete assessment that included taking down their full medical histories, performing a thorough physical exam, undergoing echocardiography, and getting a 12-lead electrocardiogram (ECG). For the purpose of determining whether left ventricular hypertrophy (LVH) existed, four electrocardiographic criteria were used. The Sokolow-Lyon index, the Romhilt and Estes scoring system, the Cornell voltage criteria, and the Gubner voltage criteria are some of the recognized methods for assessing cardiac hypertrophy [9].

Left ventricular hypertrophy (LVH) was assessed using electrocardiography (ECG) by employing the following criteria:The Sokolow-Lyon criterion is a widely used method in clinical cardiology for assessing left ventricular hypertrophy. The amplitude of the S wave in leads VI and the R wave in leads V5 and V6 (whichever is larger) is greater than 35 mm. Additionally, the amplitude of the R wave in lead aVL is greater than 11 mm.The existence of specific electrocardiogram (ECG) data can suggest the possibility of left ventricular hypertrophy (LVH) in accordance with the Cornell criteria. Indicators of LVH in men include S waves in lead V3 and R waves in lead aVL bigger than 28 mm. A S wave in lead V3 and a R wave in lead aVIL that are both greater than 20 mm are considered signs of LVH in females.A diagnostic score is deemed to be more than 5 in the Romhilt-Estes scoring system, while a probable score is considered to be greater than 4 [9].

The term "voltage criteria" refers to the particular requirements or benchmarks that are employed to judge or evaluate the voltage levels in a particular system or circuit. Three electrodes are normally put on the patient's limbs as part of the electrocardiography (ECG) limb leads. The R or S leads are popular names for these electrodes. While the R wave in leads V5/V6 has an amplitude greater than 30 mm, the S wave in leads VI or V2 has an amplitude greater than 20 mm. There are three situations in which the ST/T wave vector is the opposite of the QRS complex when digitalis is present, as opposed to just one such event when it is not. Left atrial hypertrophy is indicated by a negative terminal P wave in lead VI that is 1 mm deep and 0.04 seconds long. There are two QRS durations that are greater than 0.09 seconds when the left axis deviation of the QRS complex is equal to or greater than -30. Leads V5 and V6 exhibit a delayed intrinsicoid deflection with a duration more than 0.05 seconds, which is suggestive [9].

The total of the R wave amplitude in lead 1 and the S wave amplitude in lead 3 should be greater than 24 millimeters in accordance with the Gubner voltage requirement.

GE ECHO equipment was used to do echocardiography. The American Society of Echocardiography's (ASE) predetermined criteria were used to draw the boundaries. The area-length approach, which involved using data derived from 3D echocardiographic imaging, was used to calculate the left ventricular mass. Calculating the difference between the left ventricular epicardial volume and the left ventricular endocardial volume will yield the left ventricular mass. The volume of the left ventricular myocardium is represented by the number 1.05. 1.05 g/mL is the myocardial density measurement [9].

The cross-sectional areas of the epicardium and endocardium in the short-axis view at the level of the papillary muscle were measured to calculate the mean wall thickness. The papillary muscles were incorporated into the left ventricular chamber, it should be highlighted. Centimeters were used as the measurement unit throughout all measurements, which were made during the diastolic phase. Three-dimensional echocardiography was used to measure the mass of the left ventricle.

The SPSS software (version 17, SPSS, Chicago, IL) was used to carry out the statistical analysis. Both numerical and percentage representations were used to present the data. The determination of specificity and sensitivity was carried out after the results of diagnostic validity tests, notably the ECG and echocardiography, were evaluated. The Kappa measure of

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agreement was subsequently used. P-values less than 0.05 were considered significant.

RESULTS:

The average age of patients with left ventricular hypertrophy (LVH) was found to be 58.45 ± 7.88 years old in the current study, with a higher percentage of male participants making up 77% of the sample. The participants in the study had an average BMI of 27.56. The study also showed that both sexes suffer from a number of co-morbidities. The most common co-morbidity among males was obesity, while the most prevalent co-morbidity among females was coronary artery disease (CAD) (Table 1).

The results of the present investigation showed that all participants had hypertension and a significant proportion of them had coronary artery disease (CAD). The majority of the male participants also acknowledged that they once smoked. It was found that among the various criteria used to diagnosis LVH, the ECG LVH Sokolow Lyon criteria could be utilized to identify a maximum of 52.8% of patients with LVH. The next method was the Cornell voltage CR criterion, which identified LVH in 38.9% of instances (Table 2).The average left ventricular mass of the study participants was found to be 227.8 ± 52.18g.A variety of electrocardiogram (ECG) criteria for the detection of left ventricular hypertrophy (LVH) were evaluated for their sensitivity and specificity.The Sokolow Lyon criteria had a notable level of sensitivity for the diagnosis of left ventricular hypertrophy (LVH), but the Romhilt Estes criteria had a maximum specificity of 98% (Table 3).

Table 1: Presence of comorbidities in recruited patients

	Female N (%)	Male N (%)	Total N (%)
Obesity	18 (58%)	42 (64.54%)	60 (55:6%)
Coronary artery disease	24 (77.4%)	38 (49.4%)	62 (57.4%)
Left ventricular systolic dysfunction	10 (32.3%)	22 (28.5%)	32 (29.6%)
Chronic kidney disease	8 (25.8%)	13 (16.1%	21 (19.4%)
Total	31 (28.7%)	77 (71.3%)	108 (100%)

Table 2: Distribution of patients according to diagnostic criteria of ECG to detect Left ventricular hupertrophy

	N (%)
Romhilt Estes criteria	31 (28.7%)
Gubner voltage criteria	26 (24.1%)
Left ventricular hypertrophy Sokolow Lyon criteria	57 (52.8%)
Cornell voltage criteria	42 (38.9%)

Table 3: Sensitivity and specificity of patients according to diagnostic criteria of ECG to detect Left ventricular hupertrophy

	Kappa coefficient	Specificity (%)	Sensitivity (%)	p-value
Romhilt Estes criteria	0.007	98%	27%	0.578
Gubner voltage criteria	-0.018	93%	21%	0.067
Left ventricular hypertrophy Sokolow Lyon criteria	-0.018	92%	38%	0.356
Cornell voltage criteria	-0.019	94%	33%	0.019

DISCUSSION:

An increased hemodynamic stress on the heart is linked to the beginning of left ventricular hypertrophy (LVH). As a result, early detection and prediction of many cardiovascular diseases depend greatly on the prompt detection of left ventricular hypertrophy (LVH). It is essential to prioritize a high level of sensitivity since the 12-lead electrocardiogram (ECG) is frequently used as a diagnostic tool for left ventricular hypertrophy (LVH). The use of echocardiography has been widespread for many years and has become a well-known non-invasive imaging technique for assessing the structure and function of the heart [10].

According to a widely accepted theory, there is a positive association between aging and left ventricular (LV) mass, which in turn causes a rise in the amount of fibrous tissue that is electrically inactive. Because conduction issues are more common in elderly people, electrocardiography (ECG) is less accurate for detecting left ventricular hypertrophy (LVH). Left ventricular hypertrophy (LVH) is underreported as a result of decreased sensitivity in electrocardiogram (ECG) examinations [11]. This study's main goal was to explore four important electrocardiographic indicators of left ventricular hypertrophy (LVH), with three-dimensional echocardiography (3D ECHO) serving as the gold standard for diagnosis.

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A popular and quick method for diagnosing LVH is the Sokolow-Lyon criteria for electrocardiographic (ECG) left ventricular hypertrophy (LVH).The current study shown that the presence of multiple co-morbidities resulted in the highest sensitivity for identifying left ventricular hypertrophy (LVH). The Kappa measure of agreement yielded a value of 0.018, suggesting a limited level of agreement between ECHO and ECG in the diagnosis of LVH. The aforementioned criterion demonstrated a sensitivity rate of 38% and a specificity rate of 92%. In line with our investigation, Singh *et al* [8] and Martin *et al* [11] observed comparable ranges of Kappa coefficient values and sensitivity, alongside a specificity of 75%.

A sensitivity of 21% and specificity of 95% were reported by Reichek *et al* [12], demonstrating a poor sensitivity and high specificity. The experiments carried out by Murphy *et al* [13] and Jaggy *et al* [14] shown a significant level of specificity, ranging from 75% to 80%, and sensitivity, about 60%.

For the purpose of scoring, the Romhilt Estes criteria use a sophisticated data evaluation process. A low level of agreement between the two investigations is shown by the Kappa measure of agreement, which was found to be 0.007. When comparing the amount of specificity stated in relation to the Sokolow-Lyon criterion, it is crucial to acknowledge that the former is of a greater magnitude. Sensitivity and specificity rates from the trial were 27% and 98%, respectively. Notably, among all the criteria, the specificity rate was discovered to be the highest, while the sensitivity rate was discovered to be the lowest. However, the sensitivity of the Romhilt criteria is increased to 50% in the presence of left ventricular systolic failure. Singh *et al*.'s [8] study revealed an increased sensitivity of 47% and a decreased specificity of 75%. The results of our own analysis are consistent with those published by Reichek *et al* [12], Murphy *et al* [13], and Kansal *et al* [15], who showed a greater sensitivity range of 50-60% and equivalent specificity range of 81-95% in their respective studies.

Furthermore, it was discovered that among people with chronic kidney disease (CKD), the Cornell voltage criteria showed a high level of sensitivity in detecting left ventricular hypertrophy (LVH). The Echo method has a sensitivity of 33% and a specificity of 94%. The link between Echo and ECG is statistically significant, as shown by the kappa coefficient of 0.019, which quantifies the agreement between the two tests. Similar findings were published by Lv *et al*. (year), who showed a stronger association between Echo-LVH and the Cornell-related criterion. The Gubner voltage CR demonstrated a low kappa agreement of 0.018 between the two study techniques while exhibiting a sensitivity and specificity in the range of 21% and 93%, respectively.

CONCLUSION:

The results of our investigation show that the Romhilt Estes criteria had the highest degree of specificity in the diagnosis of left ventricular hypertrophy (LVH), while the ECG LVH Sokolow Lyon criteria had the highest level of sensitivity. The most accurate diagnostic device for spotting left ventricular hypertrophy (LVH) in individuals with co-morbidities was found to be the ECG LVH Sokolow Lyon CR criteria. Electrocardiography (ECG) is found to be ineffective when assessing individuals for left ventricular hypertrophy (LVH) using widely accepted criteria. Instead, echocardiography is thought to be the best technique for evaluating LVH because it not only helps with diagnosis but also makes it possible to quantify left ventricular mass. In these cases, the additional information from the echocardiogram has a high prognostic value.

REFERENCES:

1. Kotchen TA. Harrison's Principles of Internal Medicine. 17th ed. New York: McGraw Hill; 2008. Hypertensive Vascular Disease. In: Fauci AS, Braunwald E, Kasper DL, Hauser SL, Longo DL, Jameson JL, *et al*., editors.
2. Kotchen TA. Harrison's Principles of Internal Medicine. 18th ed. New York: McGraw Hill; 2012. Hypertensive Vascular Disease. In: Longo DL, Fauci AS, Kasper DL, Hauser SL, Jameson JL, Loscalzo J, *et al*., editors.
3. Gupta R, Gupta VP. Hypertension epidemiology in India: lessons from Jaipur Heart Watch. Current Science. 2009;97:349–55.
4. Izzo JL, Gradman AH. Mechanisms and management of hypertensive heart disease: from left ventricular hypertrophy to heart failure. Med Clin N Am. 2004;88:1257–71.
5. Marcato J, Senra SF, Gama PA, Lenci MG.Evaluation of Different Criteria in the Diagnosis of Left Ventricular Hypertrophy by Electrocardiogram in Comparison with Echocardiogram. Cures 2022:14(6):e26376.
6. Lv T, Yuan Y, Yang J, Wang G, Kong L, Li H*et al*.The association between ECG criteria and Echo criteria for left ventricular hypertrophy in a generalChinese population.AnnNon-invasiveElectrocardiol. 2021:26(5):e12880.
7. Bayram N, Akoglu H, Sanri E, Karacabey S, Efeoglu M, Onur O *et al*. Diagnostic Accuracy of the Electrocardiography Criteria for Left Ventricular Hypertrophy (Cornell Voltage Criteria, Sokolow-Lyon Index, Romhilt-Estes, and Peguero-Lo Presti Criteria)ComparedTOTransthoracicEchocardiography. Cureus. 2021;13(3):13883.
8. Singh G, Bawa AGS, Kapila S, Kaur A, Garg S.Comparison of electrocardiographic criterias forLVH using Echocardiography as standard. Int J Contem Med Res. 2017;4(2):497-500.
9. Mathur R, Sarda P, BaroopalA, Kumar P, Sakwaria A. Comparison of electrocardiogram diagnostic criteria in diagnosis of left ventricular hypertrophy using 3D echocardiography as standard. Int J Res Med Sci2023;11:857-62
10. Okin PM, Jackson TW, Markku SN, Sverker J, AnneLT, Robert P*et al*. Ethnic difference in electrocardiographic

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criteria for left ventricular hypertrophy: the LIFE study. Losartan Intervention for Endpoint. Am J Hypert. 2002;15(8):663-71.

11. Martin TC, Bhaskar YG, Umesh KV. Sensitivity and specificity of the electrocardiogram in predicting the presence of increased left ventricular mass index on the echocardiogram in Afro-Caribbean hypertensive patients. West Indian Med J. 2007;56:134-8.
12. Reichek N, Devereux RB. Left ventricular hypertrophy:relationship of anatomic,echocardiographic and electrocardiographic findings.Circulation. 1981:63:1391-8.
13. Murphy ML, Thenabadu PN, de Soyza N, Meade J,DohertyJE, Baker BJ.Sensitivity ofelectrocardiographic criteria for left ventricular hypertrophy according to type of cardiac disease. Am J Cardiol. 1985;55:545-9.
14. Jaggy C, Perret F, Bovet P, van Melle G, ZerkiebelN. Madeleine G *et al*. Performance of classic electrocardiographic criteria for left ventricular hypertrophy in an African population. Hypertension.2000;36:54-61
15. Kansal S, Roitman DI, Sheffield LT. A quantitative relationship of electrocardiographic criteria of left ventricular hypertrophy with echocardiographic left ventricular mass: a multivariate approach. Clin Cardiol. 1983;6:456-63.