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Peguero–Lo Presti ECG for Detecting Concentric LVH in Hypertensive Patients: A Study in Padang, Indonesia

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ABSTRACT

Background: Concentric left ventricular hypertrophy (LVH) is a common complication of hypertension and is associated with increased cardiovascular morbidity and mortality. Although echocardiography remains the gold standard for diagnosing LVH, electrocardiography (ECG) provides a more accessible and cost-effective alternative. This study aimed to evaluate the diagnostic accuracy of the Peguero–Lo Presti (PLP) ECG criteria for detecting concentric LVH in hypertensive patients. Methods: A cross-sectional diagnostic study was conducted among 90 hypertensive patients admitted to a tertiary hospital in Padang, Indonesia, from July to December 2025. All participants underwent standard 12-lead ECG and echocardiographic examinations. Diagnostic performance of the PLP criteria was assessed using sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall accuracy. Results: Concentric LVH was identified in 65.60% of patients based on echocardiography. The PLP ECG criteria demonstrated a sensitivity of 79.66%, specificity of 90.32%, PPV of 94.00%, NPV of 70.00%, and diagnostic accuracy of 83.33%. Most participants were female, older than 65 years, and overweight. Conclusion: The Peguero–Lo Presti ECG criteria showed good diagnostic performance and may serve as a practical screening tool for early detection of concentric LVH in hypertensive patients, particularly in resource-limited settings.

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INTRODUCTION

Hypertension remains a leading contributor to global morbidity and mortality, particularly due to its strong association with cardiovascular diseases such as coronary artery disease, heart failure, and stroke (Angeli, 2023). Epidemiological evidence indicates a continuous rise in the prevalence of hypertension worldwide, posing a significant burden on healthcare systems. One of the most common forms of hypertension-mediated target organ damage is left ventricular hypertrophy (LVH), which reflects the adaptive response of the myocardium to chronic pressure overload (Tatavarthy et al., 2024; Tomlinson, 2025). Historically, LVH was often detected at advanced stages when clinical manifestations had already developed. However, advances in diagnostic modalities have enabled earlier identification of structural cardiac changes. In contemporary clinical practice, attention has shifted not only to the presence of LVH but also to its geometric patterns, where concentric LVH is recognized as having a higher risk of adverse cardiovascular outcomes compared to other patterns. This underscores the need for accurate, rapid, and accessible diagnostic methods for early detection (Barbieri et al., 2021; Millisani & Karolina, 2025; Naderi et al., 2025).

Echocardiography is widely regarded as the gold standard for assessing left ventricular geometry due to its ability to provide detailed structural and functional cardiac evaluation. Nevertheless, its use is often limited by availability, cost, and the need for specialized expertise, particularly in resource-constrained healthcare settings (Guta et al., 2019). In contrast, electrocardiography (ECG) is a widely available, low-cost, and rapid diagnostic tool, making it highly suitable for initial screening of LVH. Several ECG criteria, including the Sokolow–Lyon and Cornell voltage criteria, have been developed; however, their sensitivity in detecting LVH remains suboptimal, especially among hypertensive patients. The Peguero–Lo Presti (PLP) electrocardiographic criteria have been introduced as a novel approach, demonstrating improved sensitivity and specificity compared to traditional criteria (Gaber et al., 2025; Muhammad Daniyal, 2025). From a theoretical and clinical perspective, improved diagnostic performance of ECG criteria could enhance early detection of LVH, enabling timely intervention and reducing the risk of cardiovascular complications. Therefore, evaluating the diagnostic value of PLP criteria is essential for both advancing clinical knowledge and improving patient care.

Despite the recognized importance of early LVH detection, there remains a gap between the need for effective screening tools and the limitations of existing diagnostic modalities. While echocardiography provides high diagnostic accuracy, its accessibility is not universally guaranteed, necessitating alternative approaches that are both practical and reliable. The PLP ECG criteria offer a promising solution; however, evidence regarding their diagnostic accuracy, particularly for identifying concentric LVH in hypertensive populations within specific local contexts, is still limited. Accordingly, this study aims to assess the diagnostic accuracy of Peguero–Lo Presti ECG criteria compared with echocardiography as the reference standard. The findings are expected to provide scientific evidence supporting the use of ECG as an effective screening tool, ultimately contributing to earlier detection and improved prevention of cardiovascular complications in hypertensive patients.

RESEARCH METHOD

Study Design

This study was a diagnostic test study with a cross-sectional design. It was conducted at the inpatient department of a tertiary care hospital in Padang, Indonesia, over a 6-month period from July to December 2025.

Population and Sample

The study population consisted of hypertensive patients admitted to the hospital during the study period. Eligible participants were those aged >18 years with systolic blood pressure ≥140 mmHg and/or diastolic blood pressure ≥90 mmHg, diagnosed with cardiomegaly and having a left

ventricular ejection fraction (LVEF) ≥50%. All participants provided written informed consent prior to inclusion.

Exclusion criteria included patients with conditions that could interfere with electrocardiographic interpretation or cardiac structure assessment, such as barrel chest, total atrioventricular block, bundle branch block, atrial fibrillation, atrial flutter, pacemaker implantation, congenital heart disease, valvular heart disease, endocarditis, pericarditis, myocarditis, pericardial effusion, pleural effusion, obesity, and patients with conditions preventing ECG or echocardiographic examination (e.g., burns at electrode placement sites). A total of 90 subjects were recruited using a consecutive sampling technique.

Data Collection

Baseline characteristics were collected for all participants, including age, sex, body weight, height, blood pressure, duration of hypertension, body mass index (BMI), cardiovascular risk factors, comorbidities, and medication history. BMI was calculated as weight (kg) divided by height squared (m^2) and categorized according to standard classifications.

Blood pressure was measured in millimeters of mercury (mmHg), and hypertension staging was defined according to the Joint National Committee 8 (JNC 8) criteria. Risk factors included smoking status, while comorbidities included diabetes mellitus, dyslipidemia, chronic kidney disease, and coronary artery disease. Medication history included antihypertensive therapy such as angiotensin-converting enzyme inhibitors (ACEIs), angiotensin receptor blockers (ARBs), calcium channel blockers (CCBs), diuretics, and beta-blockers, categorized as single, dual, or triple therapy.

All participants underwent a standard 12-lead electrocardiography (ECG) examination using a calibrated device at a paper speed of 25 mm/s and a voltage of 10 mm/mV. Left ventricular hypertrophy (LVH) was determined using the Peguero–Lo Presti (PLP) criteria, defined as the sum of the deepest S wave in any lead (SD) plus the S wave in lead V4 (SV4) ≥2.8 mV in men and ≥2.3 mV in women.

Echocardiographic examination was performed by a cardiology consultant using a two-dimensional echocardiography system (GE Logiq) with M-mode assessment to evaluate left ventricular geometry. Measurements included interventricular septal thickness (IVS), left ventricular internal diameter (LVID), and posterior wall thickness (PWT). Left ventricular mass (LVM) was calculated using the formula:

$$LVM\left(g\right) = 0.8 \times \left[1.04 \times \left(\left(IVS + LVID + PWT\right)^3 - \left(LVID\right)^3\right)\right] + 0.6 \quad (1)$$

Body surface area (BSA) was calculated as:

$$BSA = \sqrt{\frac{\left(height\ \left(cm\right) \times weight\ \left(kg\right)\right)}{3600}} \quad (2)$$

Left ventricular mass index (LVMI) was obtained by dividing LVM by BSA. Relative wall thickness (RWT) was calculated as:

$$RWT = \frac{\left(2 \times PWT\right)}{LVEDD} \quad (3)$$

Concentric LVH was defined as LVMI >115 g/m^2 in men and >95 g/m^2 in women, with RWT >0.42.

Data Analysis

Descriptive analysis was performed to summarize baseline characteristics. The diagnostic performance of the PLP ECG criteria was evaluated against echocardiography as the reference standard using a 2×2 contingency table. The parameters assessed included sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall diagnostic accuracy.

Sensitivity was defined as the proportion of true positives among patients with concentric LVH, calculated as

$$\frac{TP}{(TP + FN)} \quad (4)$$

Specificity was defined as,

$$\frac{TN}{(TN + FP)} \quad (5)$$

PPV was calculated as

$$\frac{TP}{(TP + FP)} \quad (6)$$

and NPV as,

$$\frac{TN}{(TN + FN)} \quad (7)$$

Diagnostic accuracy was defined as

$$\frac{(TP + TN)}{total\ sample\ size} \quad (8)$$

RESULTS AND DISCUSSIONS

Basic characteristics of the study

This study was conducted on 90 hypertensive patients at the inpatient unit of Dr. M. Djamil Padang hospital who met the inclusion and exclusion criteria. The individual characteristics of hypertensive patients suspected of having concentric left ventricular hypertrophy can be seen in Table 1. Basic characteristics of the study, which include gender, age, BMI, systolic blood pressure, diastolic blood pressure, duration of hypertension, risk factors, comorbidities, and medication history.

Table 1. Basic Characteristics of the Study

Characteristics	n = 90 (%)	Mean ± SD
Gender		
Male	34 (37.80)	
Female	56 (62.20)	
Age (years)		53.87 ± 13.33
26 - 35 years	9 (10.00)	
36 - 45 years	12 (13.30)	
46 - 55 years	14 (15.60)	
56 - 65 years	26 (28.90)	
> 65 years	29 (32.20)	
Body mass index (kg/m^2)		23.71 ± 0.98
Normal (18.5 – 22.9)	20 (22.20)	
Overweight (23 – 24.99)	70 (77.80)	
Systolic blood pressure (mmHg)		157.16 ± 11.35
Diastolic blood pressure (mmHg)		71.58 ± 5.79
Characteristics	n = 90 (%)	Mean ± SD
Hypertension stage		
Stage 1 hypertension	56 (62.22)	
Stage 2 hypertension	34 (37.78)	
Hypertension duration (years)		4.93 ± 2.37
Diabetes mellitus		
Present	24 (26.70)	
Absent	66 (73.30)	
Dyslipidemia	21 (23.30)	
Present Absent	69 (76.70)	

Chronic kidney disease	
Present	35 (38.90)
Absent	55 (61.10)
Coronary heart disease	
Present	9 (10.00)
Absent	81 (90.00)
Smoking history	
Present	16 (17.80)
Absent	74 (82.20)
Medication history	
ACEI	57 (63.30)
ARB	23 (25.60)
CCB	59 (65.60)
Diuretics	10 (11.10)
Beta blocker	14 (15.60)
Anti-hypertensive combination	
Single	27 (30.00)
Double	39 (43.33)
Triple	24 (26.67)

Based on Table 1, hypertensive patients suspected of having concentric left ventricular hypertrophy in this study were mostly found in females, with a percentage of 62.20% and 37.80% in men. Individuals in this study were almost half in the age category >65 years at 32.20% with a mean of 53.87 ± 13.33 years. In this study, weight and height checks were carried out and then calculated body mass index (BMI), with most of the BMI in the overweight category as many as 70 (77.80%) with a mean of 23.71 ± 0.98 kg/m2. Then the average systolic blood pressure of the subjects was 157.16 ± 11.35 mmHg and diastolic blood pressure 71.58 ± 5.79 mmHg, stage 1 hypertension as many as 56 (62.22%), with an average duration of hypertension of 4.93 ± 2.37 years.

Individuals with a history of diabetes mellitus were 24 (26.70%), dyslipidemia 21 (23.30%), chronic kidney disease 35 (38.90%), and coronary heart disease 9 (10%). Most individuals did not have a history of smoking as many as 74 (82.20%). In medication history, most individuals had a history of ACEI drug consumption of 57 (63.30%) and CCB 59 (65.60%). The use of antihypertensive drug combinations showed that almost half of the individuals, 39 (43.34%), used two-drug combinations.

Echocardiography and electrocardiography examination results

Echocardiographic examination was performed on all study samples. It was found that the results of echocardiographic examination in hypertensive patients showed a mean RWT of 0.51± 0.12, and a mean LVMI of 129.03 ± 40.94 g/m2. The results of echocardiographic examination also showed that most individuals with concentric left ventricular geometry were 59 (65.60%), followed by normal categories 17 (18.90%), concentric remodelling 10 (11.10%), and eccentric 4 (4.40%). Electrocardiographic examination was performed on all study samples. It was found that the frequency of left ventricular hypertrophy in hypertensive patients based on Peguero-Lo Presti criteria from ECG examination was 50 (55.56%) individuals, more than those who did not experience left ventricular hypertrophy as many as 40 (44.44%) individuals.

Diagnostic value of electrocardiographic examination of Peguero-Lo Presti criteria for diagnosing concentric left ventricular hypertrophy in hypertensive patients. Hypertensive patients suspected of having concentric left ventricular hypertrophy were examined in a total of 90 samples. All samples were examined using echocardiography. From the echocardiographic examination, it was found that there were 59 patients with concentric left ventricular hypertrophy. The value of electrocardiographic diagnosis of Peguero-Lo Presti criteria for diagnosing concentric left ventricular

hypertrophy in hypertensive patients was assessed by testing the results of echocardiographic examination as a gold standard. The diagnosis test was carried out with a 2x2 table, resulting in a sensitivity of 79.66%, specificity of 90.32%, positive predictive value of 94.00%, negative predictive value of 70%, and diagnostic accuracy of 83.33%.

DISCUSSION

The present study found that the majority of hypertensive patients exhibited concentric left ventricular hypertrophy (LVH), consistent with earlier reports showing concentric patterns as the predominant geometric alteration in long-standing hypertension.8,9 The dominance of concentric LVH reflects chronic pressure overload, which induces parallel sarcomere addition, increased left ventricular mass index (LVMI), and elevated relative wall thickness (RWT). This pattern was also supported by echocardiographic findings in our population, whose mean RWT and LVMI aligned with previous investigations demonstrating that sustained hypertension leads to decreased ventricular compliance and increased filling pressure.22,26 Differences in the exact proportions of geometric patterns between studies may be attributed to variations in population characteristics, degree of blood pressure control, and duration of hypertension. Our findings also reinforce the utility of echocardiography as the gold standard for detecting these structural changes and highlight the relevance of evaluating cardiac geometry in hypertensive patients.

Patient characteristics in this study further corroborate known epidemiological patterns of hypertension. A higher prevalence among females and a substantial proportion in the age group >65 years are consistent with studies demonstrating that postmenopausal hormonal decline, RAAS modulation, and vascular stiffness contribute to a greater risk of hypertension in older women.10,11,12 The predominance of overweight subjects strengthens existing evidence linking excess body weight with vascular remodeling, sympathetic overactivity, and RAAS dysregulation, all of which increase the likelihood of LVH development.16,17 Comorbidities such as chronic kidney disease and coronary heart disease, along with lifestyle factors like smoking, also played a contributory role, consistent with prior findings indicating that these conditions amplify cardiovascular burden and accelerate myocardial structural changes.23–25 Collectively, these demographic and clinical characteristics provide a strong pathophysiological explanation for the high proportion of concentric LVH in our cohort.

Diagnostic evaluation using the Peguero–Lo Presti ECG criterion demonstrated good diagnostic performance, with sensitivity, specificity, PPV, NPV, and overall accuracy exceeding the values reported in several previous studies.25,8 This suggests that the criterion—when benchmarked against echocardiography—can serve as a practical and efficient screening tool for concentric LVH in hypertensive patients, particularly in settings with limited access to advanced imaging. The relatively high sensitivity in our study indicates that the criterion can identify most patients with LVH, while the strong specificity and PPV show that positive results are highly reliable. These findings underscore the clinical value of using ECG-based screening to support early detection, guide treatment decisions, and prevent long-term complications. Nevertheless, echocardiography remains essential for definitive assessment, and future research should explore whether integrating clinical variables, biomarkers, or machine-learning enhancement of ECG parameters can further improve diagnostic accuracy.

CONCLUSION

This study found that the Peguero-Lo Pesti ECG criteria have good sensitivity with high specificity. This suggests that the Peguero-Lo Pesti ECG criteria for diagnosing concentric LVH in hypertensive patients can be used for screening and early diagnostic purposes.

References

Angeli, F. (2023). New Perspectives and Strategies for the Management of Hypertension. *Journal of Cardiovascular Development and Disease*, *10*(8), 346. https://doi.org/10.3390/jcdd10080346

Barbieri, A., Albini, A., Maisano, A., De Mitri, G., Camaioni, G., Bonini, N., Mantovani, F., & Boriani, G. (2021). Clinical Value of Complex Echocardiographic Left Ventricular Hypertrophy Classification Based on Concentricity, Mass, and Volume Quantification. *Frontiers in Cardiovascular Medicine, Volume 8-2021*. https://doi.org/10.3389/fcvm.2021.667984

Gaber, E. E., El-barbary, M. A., Khalil, S. S., & Kassem, H. K. (2025). Detection of best ECG criteria for diagnosis of left ventricular hypertrophy in hypertensive Egyptian patients. *Tanta Medical Journal*, *53*(4). https://doi.org/10.4103/tmj.tmj_20_25

Guta, A. C., Badano, L. P., Ochoa-Jimenez, R. C., Genovese, D., Previtero, M., Civera, S., Ruocco, A., Bettella, N., Parati, G., & Muraru, D. (2019). Three-dimensional echocardiography to assess left ventricular geometry and function. *Expert Review of Cardiovascular Therapy*, *17*(11), 801–815. https://doi.org/10.1080/14779072.2019.1697234

Millisani, H. I., & Karolina, W. (2025). Diagnosis and differentiation of pathological concentric left ventricular hypertrophy. *Heart Science Journal*, *6*(3). https://doi.org/10.21776/ub.hsj.2025.006.03.6

Muhammad Daniyal. (2025). Peran Elektrokardiografi dan Kriteria Peguero–Lo Presti dalam Diagnosis Hipertrofi Ventrikel Kiri. *OBAT: Jurnal Riset Ilmu Farmasi Dan Kesehatan*, *3*(6), 24–33. https://doi.org/10.61132/obat.v3i6.1844

Naderi, H., Ramírez, J., Van Duijvenboden, S., Ruiz Pujadas, E., Aung, N., Wang, L., Chamling, B., Dörr, M., Markus, M. R. P., Chahal, C. A. A., Lekadir, K., Petersen, S. E., & Munroe, P. B. (2025). Diagnostic and prognostic value of ECG-predicted hypertension-mediated left ventricular hypertrophy using machine learning. *Journal of Hypertension*, *43*(8). https://doi.org/10.1097/hjh.0000000000004034

Tatavarthy, M., Stathopoulos, J., & Oktay, A. A. (2024). Prevention and treatment of hypertensive left ventricular hypertrophy. *Current Opinion in Cardiology*, *39*(4). https://doi.org/10.1097/hco.0000000000001135

Tomlinson, S. (2025). Hypertensive Left Ventricular Hypertrophy: Pathogenesis, Treatment, and Health Disparities. *Hearts*, *6*(3), 18. https://doi.org/10.3390/hearts6030018