Open Access Original Article

Diagnostic value of left ventricle strain pattern of hypertensive patients in coronary and cerebrovascular diseases

DOI: https://doi.org/10.32007/jfacmedbagdad.6331747.

Qais N. Raheem* **CABMS**
Tuka Y. Hassan** **CABMS-CM**
Ammar Q. Raheem* **MBChB, DM**
Hassan A. Al-farhan*** **FICMS cardiology, FACC, FRCPE, DIC, DMe,FICMS,FESC**

JFac Med Baghdad 2021; Vol.63, No . 3
Received: May, 2020
Accepted: Aug., 2021
Published: Oct. 2021

Abstract:

Background: Patients diagnosed with hypertension and left ventricular hypertrophy could present with electrocardiographic changes including criteria of left ventricular hypertrophy, and left ventricular strain pattern (fixed ST depression and T inversion in leads I, avL, V5&6). Therefore, current study was carried out to study the effect of electrocardiographic left ventricular strain pattern in hypertensive patient as predictor for coronary artery disease and cerebrovascular accident development.

Objectives: this study was done to identify the impact of ECG lLV strain pattern among hypertensive patient as predictor for (CAD) and cerebrovascular accident (CVA) development

Materials and methods: A cross-sectional hospital based study was done during 2012-2017 at the Iraqi Center for Heart Diseases including hypertensive patients with normal ECG or LV strain pattern criteria. All patients underwent echocardiography and coronary angiography and the data were collected from patients' files.

Results: The records of 401 hypertensive patients [262(65.3%) males and 139(34.7%) females] were included in this study. Their mean age was 60.07±10.8 year. The relation between electrocardiographic left ventricular strain pattern and coronary angiography among patients was significant (*P* <0.001). There was significant relation among electrocardiographic left ventricular strain pattern and cerebrovascular accident among studied group (*P*<0.001).

Conclusion: Electrocardiographic left ventricular strain in hypertensive patients is highly associated with coronary artery disease and cerebrovascular accident.

Keywords: Hypertension, coronary artery disease, cerebrovascular accident, electrocardiography, left ventricular strain**.**

Introduction:

Hypertension (HT) [systolic blood pressure (SBP) ≥ 140mmHg or diastolic blood pressure (DBP) ≥ 90mmHg] is a public health concern and a risk factor for cardiovascular disease (CVD). It was founded to be among 69% of patients with 1st myocardial infarction, 77% of patients with 1st stroke, 74% of patients with congestive heart failure (CHF), and 60% of patients with peripheral arterial disease. (1-3) Leftventricular (LV) strain pattern with Electrocardiographic (ECG) changes (ST segment depression; and T-wave inversion) is associated with coronary heart disease and with CVD (HT, diabetes DM). (4- 7)

Left ventricular hypertrophy (LVH) is a risk factor for cardiovascular mortality. ECG is an insensitive instrument to detect ventricular hypertrophy, among 20% of cases that has been detected by echocardiography (Echo); and detect 50% of increased left ventricular mass (LVM). It was reported that patients with HT may have LVH and as a results, it is related to high cardiovascular mortality.(4) Standard echocardiography is widely available and remains the most widely used tool for the evaluation of left ventricular structure and function in hypertensive patients (5).

* *Correspondence: Al-Imam Ali hospital, Al-Rusafa health directorate E-mail: qaisraheem8@gmail.com Ammar76@gmail.com*
***Al-Rusafa health directorate, Baghdad tukayounis1983@gmail.com*
****Dept. of medicine, College of Medicine, University of Baghdad hassanali@gmail.com*

The classic left ventricular (LV) strain pattern of ST segment depression and T-wave inversion on the left precordial leads of the standard resting ECG is a well-known marker of the presence of anatomic LVH.(6)
Stroke is a neurological disease and considered as a major risk for disability in the global. Its ischemic type formed most of cases (85%), while hemorrhagic one accounts about 15%. (8)
Coronary heart disease (CHD) is characterized by insufficient blood supply to the heart through coronary arteries. Smoking (9), obesity (10), diabetes mellitus, hypertension, high cholesterol levels, family history of CHD, and the lack of exercise increase the risk for CHD (9, 11).

Materials and Methods:
A cross-sectional hospital based study was done in the Iraqi Center for Heart Diseases Hospital. Data were collected from patients' files. All patients, who were admitted to the Iraqi Center for Heart Diseases during the period from January 2012 till January 2017, were included in the study.
Inclusion criteria: patients with history of hypertension and had LVH that was confirmed by Echocardiography were included in the study. Exclusion criteria: patient who were excluded from the study were those with other causes of LVH by Echo study like aortic stenosis, HOCM ….etc. and patients with ECG changes that interfere with diagnosis of LV strain pattern. The demographic and clinical details were collected from patients' files of studied group, which included age, sex, duration of hypertension and treatment. The presence of coronary artery disease (CAD) was determined from the result of coronary angiography while cerebral vascular accident (CVA) was determined from the history of the patient then, use a carotid doppler to confirm thickness of intima as predictor of CVA in hypertensive patients. ECG records were either normal or showing LV strain pattern. Statistical analysis of data was done by SPSS package version 22. The frequency, distribution, and mean were obtained to describe sex and age of the patients. The ECG changes, coronary heart diseases and cerebral vascular accident, were compared using Chi-squared test. The significance of the results was taken at level 0.05. Ethical consideration: an official consent was taken from the directorate of Baghdad Medical City and Iraqi Center for Heart Diseases Hospital. A verbal patient consent was taken. The patients were informed that the data will be kept confidential and will not be exposed except for the study purpose.

Results:
A total of 401 hypertensive patients, 262(65.3%) males and 139(34.7%) females with LVH; confirmed by Echo study, were enrolled in this study. Their ages ranged between 40 and 94 years. Mean age of patients was 60.07±10.83 years.

ECG changes among studied group were as follows, 301(75%) patients presented with abnormal ECG and 100 (25%) patients were with normal ECG (Table 1).

Table 1: ECG findings among patients

Abnormal ECG (LV strain pattern)	301	75.1
Normal ECG	100	24.9
Total	401	100.0

Coronary angiography was done for all patients and the results showed that there were 207(51.6%) patients with (CAD), while 194(48.4%) patients were normal (Table 2).

Table 2: Coronary angiography findings of studied group

Coronary Angiography	No.	%
CAD	207	51.6
Normal coronary angiography	194	48.4
Total	401	100

Regarding the presence of history of CVA among the studied group, there were 280(69.83%) patients who had history of CVA, while 121(30.17%) patients were without history of CVA. Table 3.

Table 3: Distribution of patients according to history of CVA

CVA	No.	%
Yes	280	69.8
No	121	30.2
Total	401	100.0

Out of all patients with abnormal ECG changes, there were 205(51.1%) patients with coronary artery disease (CAD). There was a significant association between abnormal ECG (LV strain pattern) and CAD (*P* <0.001), table 4.

Table 4: Distribution of patients according to the ECG changes and coronary angiographic findings among studied group

ECG findings		Coronary Angiography		Significance
		CAD	Normal	
Abnormal ECG (LV strain pattern)	No.	205	96	*P* <0.001
	%	51.1%	23.9%	
Normal ECG	No.	2	98	
	%	0.5%	24.4%	

According to patients' history of CVA, there were 279(69.6%) patients with LV strain pattern and CVA. There was a significant association between ECG changes of LV strain pattern and patients with history of CVA (*P* <0.001), table 5.

Table 5: Distribution of patients according to ECG changes and CVA

ECG		Cerebral Accident with CVA	Vascular without CVA	Significance
LV strain pattern	No.	279	22	
	%	69.6%	5.5%	
Normal ECG	No.	1	99	*P* <0.001
	%	0.2%	24.7%	

The final global analysis of association according to ECG findings (LV strain pattern in ECG) and other variables (CAD, CVA, both, or none) was presented in Table (6) .The statistical analysis showed that, the total patients with ECG changes of LV strain pattern were 301 from which 74(24.5%) patients had a history of CVA, 205(68.1%) had both CAD and CVA, 22(7.3%) patients of them had neither CAD nor CVA while no patient had CAD (Table 6). Patients with normal ECG were 100 patients, 2(2%) of them had CAD, one patient had CVA, none of them had both CVA and CAD, while 97(97%) patients of them had neither CAD nor CVA. Statistical analysis showed significant association between LV strain pattern and development of CAD and CVA (*P* <0.001; Table 6).

Table 6: Distribution of studied group according to the ECG findings and others variables:

ECG findings		CAD	CVA	Both CVA and CAD	None	Total	*P*
LV strain pattern	No.	0	74	205	22	301	<0.001
	%	0%	24.5%	68.1%	7.3%	100%	
Normal	No.	2	1	0	97	100	
	%	2%	1%	0%	97|%	100%	

Discussion:

The findings of the current study showed a significant association between LV strain pattern in hypertensive patients and CAD. This finding was consistent with a study done in United States (12) which concluded that the LVH and its criteria, like high voltage criteria and LV strain pattern, are highly associated with, and considered a predictive factor for, CAD. Another study,, ALLHAT Study (13) ,, that was consistent with our results concluded that LVH is related to high risk CV mortality in patients with HT independent of treatment. Some studies stated that LVH detected by ECG-LVH and echocardiography (echo-LVH) are related with high risk of CVD(14). Both ECG-LVH and ECHO-LVH have been reported to be predictors for CVD. Identifying LVH by ECG didn't depend on ECHO, indicating that ECG-LVH is an important electrophysiological markers for cardiac changes independent of LV anatomy (14). What is noticeable in current study was the percentage of patients with positive findings for CAD, among those with positive ECG LV strain pattern, was high and higher than the prevalence in other studies (13, 14). This might be due to that all patients were admitted to a tertiary center so they are basically referred for coronary angiography and all of them were hypertensive and proved by ECHO study to had LVH both of which are predictors for CAD. In addition to that, they had ECG LV strain pattern, which is documented by many studies (12-14) to be associated with CAD development. There was a significant association between ECG LV strain pattern and CVA among our patients (*P* <0.001). This result was consistent with a study done in United States which concluded that ECG LVH and ECHO LVH were predictors for CVA (15). This results was consistent with a study done in Japan (15) and concluded that both Cornell Product -LVH and Sokow-LVH are risk factors for stroke in the Japanese general population. But what we noticed in our study was that the percentage of patients with history of CVA was high; this might be due to that patients were already referred to a tertiary center for coronary angiography and they already had hypertension, so they had multi-risk factors for cardiovascular events.

Conclusion:

ECG LV strain pattern is highly associated with CAD and CVA development among patients diagnosed with hypertension and LVH.

Authors' contributions:

Dr. Qais N. Raheem: the primary coordinator of data collection, interpretation, and writing of article.
Dr. Ammar Q. : help dr. Qais N. Raheem in statistical analysis of data and writing results.
Dr. Tuka Younis Hassan: help dr. Qais N. Raheem in statistical analysis of data and writing

References:

1. Aronow WS, Fleg JL, Pepine CJ, Artinian NT, Bakris G, Brown AS, et al. ACCF/AHA 2011 expert consensus document on hypertension in the elderly: a report of the American College of Cardiology Foundation Task Force on Clinical Expert Consensus documents developed in collaboration with the

American Academy of Neurology, American Geriatrics Society, American Society for Preventive Cardiology, American Society of Hypertension, American Society of Nephrology, Association of Black Cardiologists, and European Society of Hypertension. J Am Coll Cardiol. 2011; 57(20): 2037-2114.

2. Aronow WS, Ahmed MI, Ekundayo OJ, Allman RM, Ahmed A: A propensity-matched study of the association of peripheral arterial disease with cardiovascular outcomes in community-dwelling older adults. Am J Cardiol. 2009; 103(1): 130-135.

3. Law MR, Morris JK, Wald NJ: Use of blood pressure lowering drugs in the prevention of cardiovascular disease: meta-analysis of 147 randomised trials in the context of expectations from prospective epidemiological studies. BMJ. 2009; 338: b1665.

4. Lang RM, Badano LP, Mor-Avi V, Afilalo J, Armstrong A, Ernande A, et al: Recommendations for cardiac chamber quantification by echocardiography in adults: an update from the American Society of Echocardiography and the European Association of Cardiovascular Imaging. J Am Soc Echocardiogr. 2015; 28(1): 1-39.e14. doi: 10.1016/j.echo.2014.10.003.

5. Kanrar A, Chaudhuri A, Ghosh A, Adhya D, Das P, Banerjee S: Electrocardiographic changes in patients of postcerebrovascular accident in rural population of Eastern India. Saudi J Sports Med. 2015; 15(2): 160-165.

6. Okin PM, Devereux RB, Nieminen MS, Jern S, Oikarinen L, Viitasalo M, et al. Relationship of the electrocardiographic strain pattern to left ventricular structure and function in hypertensive patients: the LIFE study. Losartan Intervention For End point. J Am Coll Cardiol. 2001; 38(2): 514-520.

7. Schillaci G, Pirro M, Pasqualini L, Vaudo G, Ronti T, Gemelli F, Marchesi S, Reboldi G, Porcellati C, Mannarino E. Prognostic significance of isolated, non-specific left ventricular repolarization abnormalities in hypertension. J Hypertens. 2004; 22: 407– 414.

8. Saenger AK, Christenson RH. Stroke biomarkers: progress and challenges for diagnosis, prognosis, differentiation, and treatment. Clin Chem 2010, 56(1):21-33.

9. Pinho RA, Araujo MC, Ghisi GL, Benetti M. Coronary heart disease, physical exercise and oxidative stress. Arq Bras Cardiol. 2010; 94(4): 549-555.

10. Jaber R, Hassan A, Taqa L. Echocardiographic Assessment of Left Ventricular Function in Overweight and Obese Subjects. J Fac Med Bagdad. 2014; 56(1): 25-9. Available from: http://iqjmc.uobaghdad.edu.iq/index.php/19JFacMedBaghdad36/article/view/420

11. AL-rubae S. Evaluating coronary artery disease in type 2 diabetes mellitus and Other Risk Factors by angiographic study. J Fac Med Bagdad.2011; 53(1): 15-9. Available from: http://iqjmc.uobaghdad.edu.iq/index.php/19JFacMedBaghdad36/article/view/901

12. Rautaharju PM, Soliman EZ. Electrocardiographic left ventricular hypertrophy and the risk of adverse cardiovascular events: a critical appraisal. J Electrocardiol. 2014; 47: 649–654. [PubMed]

13. ALLHAT Collaborative Research Group:. Electrocardiographic Left Ventricular Hypertrophy Predicts Cardiovascular Morbidity and Mortality in Hypertensive Patients: The ALLHAT Study. Am J Cardiol. 2016; 117(11): 1831-5

14. Leigh JA: Electrocardiographic Left Ventricular Hypertrophy as a Predictor of Cardiovascular Disease Independent of Left Ventricular Anatomy in Subjects Aged ≥65 Years. Am J Hypertens. 2017; 30(9): 914-922.

15. O`Neal WT, Almahmoud MF, Qureshi WT, Soliman EZ. Electrocardiographic and Echocardiographic Left Ventricular Hypertrophy in the Prediction of Stroke in the Elderly. J Stroke Cerebrovasc Dis. 2015; 9: 1991-7.

القيمة التشخيصية لنمط إجهاد البطين الأيسر لمرضى ارتفاع ضغط الدم مع أمراض الشرايين

د.قيس نعمة رحيم: اختصاصي باطنية/ تخصص دقيق في التداخل القسطاري/ مستشفى الامام علي/ دائرة صحة الرصافة
د. تقى يونس حسن: اختصاص طب المجتمع / دائرة صحة بغداد-الرصافة
د. عمار قحطان رحيم/ اختصاص باطنية/مستشفى الامام علي ع/ دائرة صحة بغداد-الرصافة
أستاذ مساعد.د. حسن علي الفرحان/ استشاري الامراض القلبية/ رئيس المجلس العلمي لامراض القلب

المقدمة: المرضى الذين يعانون من ارتفاع ضغط الدم وتضخم البطين الايسر قد يوجد لديهم تغيرات في التخطيط الكهربائي للقلب وهذه التغيرات قد تتمثل بعلامات تضخم البطين الايسر للقلب المتلازمة بعلامات الشد على البطين الايسر او بدونها وهولاء المرضى يكونون اكثر عرضة للاصابة بامراض شرايين القلب وجلطات الدماغ.
الأهداف: اثبات ان التغيرات في التخطيط الكهربائي في القلب التي تطرأ على المرضى المصابين بارتفاع ضغط الدم وتضخم البطين الايسرتعتبر كمؤشر للاصابة بالجلطات الدماغية وامراض الشراين التاجية.
المنهجية: أجريت هذه الدراسة في المركز العراقي لامراض القلب, مدينة الطب, بغداد, العراق, للفترة من كانون الثاني 2012 لغاية الاول من كانون الثاني 2017 .المرضى اللذين تم تشخيص اصابتهم بمرض ارتفاع ضغط الدم واثبات اصابتهم بتضخم البطين الايسر تم شمولهم بهذه الدراسم الوصفية ,ايضا تم تشخيص بقية الامراض المصاحبة مثل اصابات الاوعية الدماغية وامراض الشراين التاجية. تم اجراء تخطيط القلب الكهربائي, الايكو والتداخل القسطاري لجميع المرضى.وقد جمعت كل المعلومات من ملفات المرضى الراقدين في المركز العراقي لامراض القلب ,مدينة الطب ,بغداد ,العراق.
النتائج: شملت الدراسة 401 مريض [262 (65,3 %) ذكور و139 (34,7%)اناث] مصابين بمرض ارتفاع ضغط الدم. معدل الاعمار (54 ∓ 10.8) سنة. وجد ان العلاقة بين اجهاد البطين الأيسر الكهربائي للقلب وتصوير الأوعية التاجية بين المرضى ذات دلالة احصائية (p=0.001) (P <0.001). كان هناك فرق كبير بين اجهاد البطين الأيسر الكهربائي للقلب والطارئة الوعائية الدماغية بين المجموعة المدروسة.
الاستنتاج: تم التوصل الى ان معظم المرضى الذين لديهم تغيرات في التخطيط الكهربائي للقلب fixed ST depression و inversion in lead (I, T avL, v5 and v6) هم مؤهلين للاصابة بالجلطات الدماغية وامراض الشراين التاجية ويمكن استخدام هذة التغيرات للتنبؤ بالاصابة بالجلطات الدماغية.
كلمات الاستدلال: ضغط الدم الشرياني ، امراض الشرايين التاجية, الجلطة الدماغية ، التخطيط الكهربائي للقلب ، اجهاد البطين الايسر