ISSN- O: 2458 - 868X, ISSN –P: 2458 - 8687

International Journal of Medical Science and Innovative Research (IJMSIR)

IJMSIR : A Medical Publication Hub

Available Online at: www.ijmsir.com

Volume – 2, Issue –6, November – December - 2017, Page No. : 129 - 134

Correlation of Electrocardiography with Echocardiography of Left Ventricular Hypertrophy in Patients with Systemic Arterial Hypertension

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Conflicts of Interest: Nil.

Abstract

Background

Left ventricular hypertrophy is a unvarying predictor of adverse CV hazards. Electrocardiography is one of most routinely used methods for diagnosing left ventricular hypertrophy due to low cost and easy availability. Echocardiography has become gold standard for detection of left ventricular hypertrophy in last few decades but it is costlier than electrocardiography and less reproducible.

Aims and objective

To identify the left ventricular hypertrophy in hypertensive patients and to find the correlation between electrocardiography and echocardiography in left ventricular hypertrophy.

Material and Methods

This study was conducted at M.M.I.M.S.R, Mullana, Ambala. Fifty patients with hypertension were included in study after fulfilling inclusion and exclusion criteria. Patients were evaluated for LVH using ECG and echocardiography. Sokolow-Lyon and Cornell index criteria were applied to all subjects and their efficacy in detecting LVH was measured in comparison to echocardiography.

Results

Among 50 patients, 28 were male and 22 were female. Mean age was 48.72±9.719 years. Echocardiography detected left ventricular hypertrophy in 82% cases. In comparison to echocardiography, Sokolow- Lyon and Cornell criteria were specific for LVH (66.67%, 88.89% respectively) , but poorly sensitive (36.59%, 39.01%) respectively. Combining both these criteria, raised the sensitivity to 48.78%. Both the criteria showed moderate correlation with echocardiography by Pearson analysis.

Conclusion

Both Sokolow-Lyon and Cornell criteria are poor screening tools due to low sensitivity. Nevertheless, during routine evaluation of patients with hypertension, if any individual is positive by any ECG criteria ,that would need assessment by echocardiography.

Keywords:*Echocardiography, Ectrocardiography, Systemic Arterial Hypertension,Left ventricular hypertrophy, Left ventricular mass.*

Introduction

Hypertension is defined as persistent rise of systemic vascular blood pressure above a threshold value. Nonetheless, evidence suggests that CV risk correlated with rise of blood pressure above approximately 115 mm Hg systolic and 75 mm Hg diastolic expands in a log-linear fashion.[1,2] HTN is a cumulative multifactorial cardiovascular disorder having multiplex and interconnected etiologies. Hypertension in India is the leading non communicable disease risk and 10% mortality is attributed to it.[3] According to NPCDCS study prevalence of hypertension is 15.95% and incidence is 3.7%. In India prevalence among males is 22%-45% and 16%-38% among females.[4] Hypertension may be categorized as primary or secondary.90-95% individuals have essential hypertension whereas secondary HTN accounts for only 5%-10%.Primary hypertension is a diagnosis of exclusion. LVH is widening and thickening of walls of the chambers of heart (left ventricle). It is not merely caused by pressure overload which leads to mechanical stress but by myriad of neuro hormonal substance that separately exercise tropic effect on heart muscle. Trophic factors include angiotensin II, aldosterone, and insulin. In contrast, LVH due to increased blood pressure is pathological, simultaneously activating fibroblast, causing interstitial fibrosis, feature found in hypertensive heart disease. As a result left ventricle size is small with raised filling during diastole, leading to decreased efficiency of energy utilization and coronary blood flow reserve remains less than anticipated for the amount of hypertrophy.[6]Causes of LVH other than hypertension -Athletic training ,Aortic valve stenosis ,Aortic insufficiency ,Mitral insufficiency ,Hypertrophic cardiomyopathy .LVH damages the functional properties of myocardium, diastolic function is affected earlier than systolic.[7] LVH is an consistent and important complication of high blood pressure. High blood pressure increases afterload, which forces functional and structural adaptation leading to LVH. Structural adaptation involves myocytes hypertrophy, high degree of polyploidy accompanied by connective tissue hyperplasia.[8] ECG and ECHO both have setbacks for detecting LVH. Evaluation of voltage and QRS duration detects increase in left ventricular mass. But both these parameters not only depend on left ventricular mass but on various person aspect like upper body fat accumulation, anthropometric data as well as cardiac conduction system characteristic.[9] So ECG LVH criteria has low sensitivity. Depending on underlying pathological condition, age, race and sex different criteria prevail for hypertrophy.[10] ECG has poor sensitivity in detecting anatomic LVH, but it is specific, quick, inexpensive, easy to do and readily available tool. Echocardiography is more sensitive and considered as gold standard and its estimate of left ventricular mass correlate well with anatomic measurement but it cannot distinguish physiological LVH from pathological LVH. ESH/ESC 2013 Guidelines for arterial hypertension management recommended echocardiography as second line study based on history, examination and laboratory tests findings.[11]

Material and Methods

The present study was carried out in the Medicine department of Maharishi Markandeshwar institute of medical science, Mullana, Ambala from october 2015 to march 2017. Total 50 individuals were enrolled in study. The patients were taken from Outpatient department (OPD) and Indoor wards of Medicine and Emergency department.

Inclusion Criteria= All cases of hypertension, irrespective of duration of hypertension and type of treatment received, suspected of having left ventricular hypertrophy, were included in the study after consent.

Exclusion Criteria = Athletic heart**,** Congenital heart disease , Valvular heart disease, Hypertrophic cardiomyopathy

Following investigations were done in all patients- Complete blood count, Blood Urea, Serum Creatinine, Random blood sugar (RBS), Urine complete examination, Chest X-ray, Electrocardiogram (ECG), Echocardiography with colour Doppler Left ventricular Mass was calculated by Devereux formula.

LV Mass = Myocardial Volume *1.05 g/cm^3

= [{IVSd + LVIDd +LVPWd}^{3}- (LVIDd)^3] * 1.05 g/cm^3.

Observations

The observations hence made have been tabulated and presented as follows:-

TABLE 1:Age group

Age group(years)	Number of cases	Percentage
<40	6	12%
40-60	41	82%
>60	3	6%

In our study mean age of patient was 48.72±9.719 years. Maximum patients 82% were in age group of 40-60 years.

Table2:sex group

Gender	Number of patients (n=50)	Percentage% (n=100%)	Cumulative percentage %
Male	28	56%	56%
Female	22	44%	100%

In this study male were more than female

Table 3:Risk factors

Risk factors	No of patients	Percentage
Smoking	29	58%
Alcohol	17	34%
None	19	38%

In our study 58% were smoker and 34% were alcoholic out of them 15 patients were both smoker and alcoholic. Only 19 patients were non smoker, non alcoholic

Table 4 (a): History of hypertension

History of hypertension	No of patient (n=50)	Percentage %
Yes	45	90%
NO	5	10%

Out of 50 patients 45 patients were having history of hypertension only 5 i.e. 10% patients had no history of hypertension.

Table 4(b): Duration of hypertension and Echo positive.

Duration of hypertension	No of patients(n=45) and percentage	Echo positive (n=37) Number and percentage	p value
< 5 years	5 (11.11%)	2, 5.4%	
5-10 years	25 (55.55%)	20, 54.05%	
>10 years	15 (33.33%)	15, 40.54%	0.008

Out of 45 patients with history of hypertension 25 patients i.e. 55.55% were having 5 to 10 years duration of hypertension, 33.33% were having hypertension more than 10 years and 11.11% patients were having hypertension less than 5 years. Out of them 37 patients were having left ventricular hypertrophy. 90% of patients with LVH were having duration of hypertension more than 5 years which was significant statistically.

Table 5: Showing Chest X ray finding.

Cardiothoracic ratio	No of patients	Percentage%	p value
Increased	10	20	
Normal	40	80	0.232

In our study only 10 patients were having cardiomegaly out of 50 patients i.e. 20% which was statistically not significant.

Table 6: Showing Electrocardiography results.

ECG results	No of patients (n=50)	Percentage %	Cumulative percentage%
POSITIVE	23	46%	46%
NEGATIVE	27	54%	100%

Electrocardiography diagnosed left ventricular hypertrophy in 23 cases (46%) and 27 cases (54%) were negative for left ventricular hypertrophy.

Table 7: Showing Echocardiography Results

ECHOCARDIOGRAPHY RESULT	No of Patients n=50	Percentage % Total = 100%
Negative	9	18%
Positive	41	82%

In our study echocardiography detected left ventricular hypertrophy in 41 cases (82%) and 9 cases (18%) were negative for left ventricular hypertrophy by echocardiography.

Table 8: Sensitivity and specificity of electrocardiographic criteria

Test	Sensitivity%	Specificity%	P value	PPV%	NPV%	Accuracy
CORNELL INDEX	39.01%	88.89%	0.225	94.11%	24.24%	48%
SOKOLOW LYON	36.59%	66.67%	0.520	83.33%	18.75%	42%
COMBINED	48.78%	69.67%	0.479	86.95%	22.22%	52%

In our study Cornell Index was having more sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), Accuracy (39.01%, 88.89%, 94.11%, 24.24%, 48%) in comparison to Sokolow Lyon criteria (36.59%, 66.67%, 83.33%, 18.75%, 42%). Combined use of both these indices result in improved sensitivity, accuracy.

Table 9: Correlation between electrocardiography and echocardiography.

		LVM(gm)
Pearson correlation(r)	SokolowLyon criteria	0.473
	Cornell index criteria	0.400
Significance (p)	Sokolow Lyon criteria	0.001
	Cornell index criteria	0.004

Both Sokolow-Lyon and Cornell have moderate degree of correlation with LVM and which is statistically significant.

Discussion

In our study maximum patients (82%) were in age group of 40 to 60 years with mean age of 48.72±9.719 years. In a study by Venugopal et al maximum patients (48%) were in age group of 50 to 59 years with mean age of 56.4 years[12]. In a study by Parkash O et al male constituted 60% of cases and female constituted 40% of cases with male : female ratio of 1.5:1.[13] In our study male were 56% and females were 44% with male: female ratio of 1.27:1.In our study 20% cases had cardiomegaly on Chest X ray. Similarly in a study by Ribero SM et al 11% patients had increased cardiothoracic ratio whereas 80% had normal cardiothoracic ratio.[14]

In our study 20 out of 25 patients had left ventricular hypertrophy who had HTN for 5-10 years and 15 out of 15 were had left ventricular hypertrophy who had hypertension more than 10 years which was statistically significant. In our study 41 out of 50 i.e. 82% were detected to have left ventricular hypertrophy by echocardiography and 9 i.e. 18% were not having left ventricular hypertrophy. In our study electrocardiography detected left ventricular hypertrophy in 23 cases (46%) out of 50 patients. 54% were negative for left ventricular hypertrophy by ECG. Cornell index of electrocardiography detected left ventricular hypertrophy in 17 (34%) patients out of 50 patients. Sensitivity, specificity, PPV, NPV and accuracy of Cornell index was 39.01%, 88.89%, 94.11%, 24.24% and 48% respectively. In our study sensitivity of Cornell index was more in smokers (64.71%) as compared to non-smoker (35.29%). Sokolow-Lyon detected left ventricular hypertrophy in 18 (36%) patients out of 50 patients. Sensitivity, specificity, PPV, NPC, accuracy of Sokolow-Lyon criteria in our study was found 36.59%, 66.67%, 83.33%, 18.75% and 42% respectively. In our study sensitivity of SL index was more in smoker as compared to non smoker. In our study Cornell index was slightly more sensitive than Sokolow-Lyon index in detecting LVH. Combined use of both these criteria improved the sensitivity of ECG for detection of left ventricular hypertrophy. In our study echo diagnosed mean of LVM was 222.01 gm which was more on males 228.20 gm then

in females 214.12gm. In our study both Sokolow-lyon and Cornell criteria were having moderate degree of correlation with left ventricular mass which was statistically significant.

Results

1. 50 subjects were included in the study and were evaluated.

2. Majority of patients were in age group of 40-60 years with mean age of 48.72±9.719 years.

3. In our study male were 56% and females were 44% with male: female ratio of 1.27:1.

4. Out of 50 patients, 58% were smoker and 34% were alcoholic and 38% were non alcoholic, non smoker.

5. In our study only 10 patients were having cardiomegaly out of 50 patients i.e. 20% and 40 patients were having normal cardiothoracic ratio which was statistically not significant.

6. Electrocardiography diagnosed left ventricular hypertrophy in 23 cases (46%) and 27 cases (54%) were negative for left ventricular hypertrophy.

7. In our study Cornell Index was having more sensitivity, specificity, PPV, NPV, Accuracy (39.01%, 88.89%, 94.11%, 24.24%, 48%) in comparison to Sokolow Lyon criteria (36.59%, 66.67%, 83.33%, 18.75%, 42%). Combined use of both these indices result in improved sensitivity (48.78%), accuracy (52%).

8. Echocardiography detected left ventricular hypertrophy in 41 cases (82%) and 9 cases (18%) were negative for left ventricular hypertrophy by echocardiography.

9. In this study mean LVM was 222.01 gm and which was more in males (228.20gm) as compared to females (214.12).

10.Both Sokolow-Lyon and Cornell criteria had moderate degree of correlation with LVM for detection of left ventricular hypertrophy, which was statistically significant.

Conclusion

LVH is a grave condition strongly linked with adverse cardiovascular events. Both Sokolow-Lyon and Cornell voltage electrocardiography criteria are inferior as screening method because of low sensitivity. But combined use of these criteria can significantly improve the diagnostic accuracy of ECG for detection of LVH. Nevertheless, during routine evaluation of patients with hypertension, if any individual is positive by any ECG criteria , that would need assessment by echocardiography. Though echo cannot be advised to assess every individual with HTN, initial workup using electrocardiography can definitely help in identifying those who require echo assessment.

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