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Original Research Article

To find out sensitivity and specificity of different ECG criteria to detect left ventricular hypertrophy in males and females.

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Abstract:
Background & Method: The aim of the study was to find out sensitivity and specificity of different ECG criteria to detect left ventricular hypertrophy in males and females. All patients with age > 20 yrs with echocardiography proven LVH were selected for study group I (cases). A total number of 55 patients were enrolled into the study group II who did not have left ventricular hypertrophy in echocardiography. The study participants were considered clinically and echocardiographically normal if they were free of alterations in the cardiac chambers, valve changes of hemodynamic significance, a significant transvalvular gradient detected by colour flow doppler, had a systolic blood pressure below 140 mmHg and a diastolic blood pressure below 90 mmHg, had no abnormalities on clinical examination and were not using any medications.
Result: A total no. of 100 patients was enrolled. Total no. of males was 71 and females were 29. Two study groups the first comprising of 45 subjects with LVH and the second comprising of 55 subjects without LVH were identified.Of the total no. of 45, patients 36 patients (80%) had LVH due to hypertension.
Conclusion: In the present study 26.7% (n=12) of cases were females and 74.3% (n=33) were males. Male: female ratio was 2.7:1 among cases. Aetiology of 80% (n=36) patients with LVH was hypertension. 15% was due to valvular heart disease (n=7). Maximum sensitivity among the ECG criteria for LVH was shown by Romhilt Estes score > 4 (57%) followed by sokolow lyon product which showed 46% sensitivity. Maximum specificity was shown by Romhilt Estes score > 5(definite LVH) and Gubner ungirdlier criteria (98.1%).

Keywords: echocardiography, ventricular, hypertrophy, LVH & ECG.

Study Designed: Observational Study.

1. Introduction

Cardiovascular disease has emerged as the dominant chronic disease in many parts of the world and is predicted to become the main cause of disability and death worldwide in the 21st century. Presently cardiovascular diseases account for nearly half of all deaths in the developed world and 25% in the developing world[1].
Hypertension is directly responsible for 57% of all stroke induced deaths and 24% of all coronary heart disease deaths. Echocardiographically determined left ventricular hypertrophy (LVH) occurs in 30% of unselected hypertensive patients.(Shmieder RE et al.2000) Hypertensive LVH forms the main bulk of patients with LVH[2]. The other causes being

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valvular heart diseases like aortic stenosis, aortic regurgitation and mitral regurgitation, hypertrophic cardiomyopathy, coarctation of aorta, left to right shunt diseases like ventricular septal defects and patent ductus arteriosus, arteriovenous fistulas, obesity and other pathologic conditions[3].

On the other hand, cardiac hypertrophy in response to excess load is nonpathologic in three circumstances: maturation in infancy and childhood, pregnancy and high level exercise[4].

Myocardial hypertrophy is defined as the chronic adaptation of the left ventricle to increased cardiac load. LVH significantly increases the risk of coronary artery disease, CHF, cerebrovascular accidents, ventricular arrhythmias and sudden death[5]. LVH increases the relative risk of mortality by two fold in subjects with coronary artery disease and by four fold in those with normal epicardial coronary arteries[6].

In India the prevalence of left ventricular hypertrophy was 21 and 31 per 1000 males and females respectively in urban population and 17 and 18 per 1000 in males and females respectively in rural population. It was most commonly associated with hypertension[7].

2. Material & Method

The present study was conducted in the Department of Medicine, J.A. Group of Hospitals associated to the G.R. Medical College, Gwalior during the period of Oct 2021 to Oct 2022. A total number of 100 subjects were studied. The study population was divided into two groups. The former group comprising of cases and the latter group of controls. The subjects of the first group were those with echocardiography proven left ventricular hypertrophy. Patients undergoing echocardiographic examination in the echocardiography clinic of the Department of Medicine were screened to find out subjects with left ventricular hypertrophy. Patients with a high index of clinical suspicion to have left ventricular hypertrophy – like those with long standing and severe hypertension, those with valvular heart diseases were motivated to undergo echocardiography.

A total number of 55 patients were enrolled into the study group II who did not have left ventricular hypertrophy in echocardiography. The study participants were considered clinically and echocardiographically normal if they were free of alterations in the cardiac chambers, valve changes of hemodynamic significance, a significant transvalvular gradient detected by colour flow doppler, had a systolic blood pressure below 140 mmHg and a diastolic blood pressure below 90 mmHg, had no abnormalities on clinical examination and were not using any medications.

Inclusion criteria for study group I

All patients with age $\geq$ 20 yrs with echocardiography proven LVH.

Exclusion criteria for study group I

Patients with a previous myocardial infarction, sinus node disease, aneurysm of the left ventricle, RBBB, LBBB Wolf Parkinson White Syndrome, cardiac pacemakers, ventricular and supraventricular arrhythmias and patients with ECG or echocardiograms of inadequate technical quality were excluded.

Of the total number of patients screened for LVH, the patients with the above mentioned exclusion criteria were avoided and a total of 45 patients were enrolled into the study.

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3. Results

Table No. 1: No. of cases classified according to gender

	Male	Female	Total
No. of cases with Echo proven LVH	33	12	45
No. of cases without LVH	38	17	55

In our study a total no. of 100 patients were enrolled. Total no. of males was 71 and females were 29. Two study groups the first comprising of 45 subjects with LVH and the second comprising of 55 subjects without LVH were identified.

Table No. 2: Aetiological distribution of Left ventricular hypertrophy

Aetiology	Male	Female	Total
Hypertension	26	10	36
Valvular heart diseases	2	0	2
Hypertrophic cardiomyopathy	5	2	7
Total	**33**	**12**	**45**

Of the total no. of 45, patients 36 patients (80%) had LVH due to hypertension.

Table No.3: Sensitivity of the ECG criteria for left ventricular hypertrophy

S. No.	ECG Criteria	Echo proven LVH	ECG showing LVH	Sensitivity
1.	Sokolow-Lyon index	45	14	31%
2.	Sokolow-Lyon rappaport index	45	17	37%
3.	Sokolow-lyon product	45	21	46%
4.	Cornell voltage criteria	45	7	15%
5.	Cornell voltage duration product	45	9	20%
6.	Romhilt-Estes point score ≥ 4	45	26	57%
7.	Romhilt-Estes point score ≥ 5	45	17	37%
8.	Gubner ungerleider criteria	45	4	8%

Maximum sensitivity among the ECG criteria for LVH was shown by Romhilt Estes score $\geq$ 4 (57%) followed by sokolow lyon product which showed 46% sensitivity.

Table No. 4: Specificity of the ECG criteria for left ventricular hypertrophy

S. No.	ECG Criteria	No. of cases without LVH	ECG not fulfilling LVH criteria	Specificity
1.	Sokolow-Lyon index	55	52	94.5%
2.	Sokolow-Lyon rappaport index	55	52	94.5%
3.	Sokolow-lyon product	55	53	96.3%
4.	Cornell voltage criteria	55	53	96.3%
5.	Cornell voltage duration product	55	53	96.3%
6.	Romhilt-Estes point score ≥ 4	55	50	90.9%
7.	Romhilt-Estes point score ≥ 5	55	54	98.1%
8.	Gubner ungerleider criteria	55	54	98.1%

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Maximum specificity among the ECG criteria for LVH was shown by Romhilt Estes score $\geq$ 5(definite LVH) and Gubner ungirdlier criteria (98.1%).

4. Discussion

Mean age of the study group was 54.2yrs. Mean age of men and women in the study group were 55.0yrs and 52.35yrs respectively. The prevalence of LVH due to all causes were maximum in the age group of 61-70 yrs viz. 35%[7].

Of all the cases with LVH, 80% (n=36) were due to hypertension and 15% (n=7) were due to valvular heart diseases.

In the present study out of the 45 patients with LVH, 37.8% (n=17) had concentric LVH and 62.2% (n=28) had eccentric LVH. In Watchell et al.'s (2001) series of 913 patients with varying stages of hypertension these percentages of various pattern were found by echocardiography. 19% normal geometry; 11% concentric remodeling; 47% eccentric hypertrophy and 23% concentric hypertrophy[8]. In Antonello Ganau et al.'s series of 165 patients with untreated essential hypertension, 52% had normal geometry, 13% concentric remodeling, 27% had eccentric LVH and 8% had concentric LVH. A 10 year follow up study showed 21% cardiovascular death and 31% morbid events in patients with concentric LVH while no cardiovascular death and 11% morbid events in those with normal geometry. The risk was intermediate for patients with concentric remodeling and eccentric LVH.

When Sokolow Lyon criterion was compared in LVH due to all causes 31% (n=14) sensitivity was found. Among hypertensive LVH the sensitivity decreased to 25%.

Sokolow Lyon criterion showed increased sensitivity in detecting LVH in females 50% than in males (24%). Even in LVH due to hypertension Sokolow Lyon criterion showed increased sensitivity in detecting LVH in females (40%) than in males (19%). Sokolow Lyon criterion fared better than the Cornell criteria and Romhilt Estes scores in detecting LVH in females[9&10].

Khaled Alfakih et al (2004) evaluated 288 hypertensives using cardiac MRI and found 28.7% sensitivity and 92.1% specificity for the Sokolow Lyon criterion which was comparable to our present study. At a fixed specificity of 95%, 20.3% combined sensitivity, 18.5% sensitivity in males and 23.3% sensitivity in females were obtained. The study of Casale et al (1985) comparing ECG criteria demonstrated that the Sokolow Lyon Index had a sensitivity of 33% and a specificity of 100%. Hsieh et al (2004) demonstrated highest sensitivities for Sokolow Lyon criterion (13.2%) and Framingham adjusted Cornell Voltage criteria (17.4%) in a study of 46,950 veterans[11].

5. Conclusion

In the present study 26.7% (n=12) of cases were females and 74.3% (n=33) were males. Male: female ratio was 2.7:1 among cases. Aetiology of 80% (n=36) patients with LVH was hypertension. 15% was due to valvular heart disease (n=7). Maximum sensitivity among the ECG criteria for LVH was shown by Romhilt Estes score > 4 (57%) followed by sokolow lyon product which showed 46% sensitivity. Maximum specificity was shown by Romhilt Estes score > 5(definite LVH) and Gubner ungirdlier criteria (98.1%).

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