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Original Research Article

Prevalence and determinants of left ventricular hypertrophy among elderly hypertensive patients attending tertiary health care center in West Bengal, India

Bijay Prakash Yadav[1], **Poonam Kushwaha**[2,*]

[1] *Dept. of Cardiology, NIMS Super Specialty Hospital, Jaipur, Rajasthan, India*
[2] *Dept. of Community Medicine, Rama Medical College Hospital and Research Centre, Kanpur, Uttar Pradesh, India*

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ABSTRACT

Background: Hypertension (HTN) is one of the most prevalent, modifiable and treatable causes of cardiovascular diseases in the elderly. Damage to cardiovascular system due to chronic hypertension causes hypertensive heart disease including left ventricular hypertrophy (LVH). It is a physiological adaptation to chronic blood pressure (BP) indicating grave prognosis and should be diagnosed early.
Aims and Objective: Present study therefore aimed to assess LVH and other Cardio-vascular (CV) changes and to ascertain correlation between the electrocardiographic (ECG) and radiographic / chest x-ray (CXR) evidences and find out their determinants among elderly hypertensive patients.
Materials and Methods: 100 elderly hypertensive subjects were included in study. Cardio-vascular changes and LVH was assessed by using chest x-ray and ECG. Other bio-chemical investigations were done also.
Results: 29% and 32% subjects had LVH detected by Chest x-ray and ECG respectively. Female, increasing age, family history and duration of HTN, smoking, alcohol consumption were found independent determinants of LVH. Subjects with LVH had higher mean blood pressures, mean pulse pressure and higher blood urea nitrogen than those without LVH. Micro-albuminuria was significantly more frequent in patients with LVH as detected by CXR. Fasting Blood sugar and dyslipidaemia was associated with greater odds of developing LVH.
Conclusion: In low resource settings, where standard diagnostic tests are unavailable- chest x-ray and ECG are the useful tools for detection of cardio vascular changes / LVH among chronic hypertensive.

1. Introduction

Epidemiological transition, the shift in mortality and disease patterns from communicable diseases to non-communicable diseases worldwide.[1] In developing countries, this transition is accelerating enormous burden of non-communicable diseases (NCDs) and cardiovascular (CV) diseases consist a major part of these NCDs.[2–4] Hypertension is one of the most prevalent, independent, potentially modifiable and treatable causes of CV diseases affecting billions of peoples worldwide particularly in the elderly population.[5,6] Damage to CV system due to undiagnosed, late diagnosed, inaccurately treated (uncontrolled) and untreated chronic hypertension causes hypertensive heart disease, which includes left ventricular hypertrophy (LVH), systolic as well as diastolic dysfunction and their clinical manifestations. Hence, regular screening of risk factors viz. a viz. age, sex, family history, occupational status (sedentary lifestyle), high salt intake, addiction, comorbidities etc. developing hypertension before target organ damage (TOD) occurs is crucial and essential aspect to timely detect and manage these TOD.

* *Corresponding author*.
E-mail address: poonammaster21@gmail.com (P. Kushwaha).

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Interaction of these risk factors increases the overall risk of development of TOD in chronic hypertension. Detection of TOD leads us to adapt a comparatively aggressive therapeutic approach, improving CV outcome and long-term prognosis as well.[5–12]

Cardiovascular changes can be diagnosed by Chest X-ray (CXR), Electrocardiogram (ECG), Echocardiography (Echo) and cardiac MR (CMR) imaging etc. CMR and Echo are sensitive and gold standard techniques to identify CV changes at early stage. While CXR and ECG are easily available, easy to use and portable examination tool but relatively insensitive and can't accurately measure the severity of CV changes.[13–15] But in low resource settings as in developing countries, CXR and ECG are the useful tools for screening and detection of CV changes where the facilities of CMR and Echo are limited or unavailable.

2. Aims and Objective

Present study was done to assess LVH and other CV changes and to ascertain correlation between the electrocardiographic and radiographic (chest x-ray) evidences and to find out the determinants of left ventricular hypertrophy among elderly hypertensive patients.

3. Materials and Methods

3.1. Study setting and population

The Institution based, descriptive, cross-sectional study was conducted among 100 elderly (≥ 60 years) hypertensive subjects in a tertiary health care centre of West Bengal. Sample size was calculated by using, 63.6% prevalence of LVH by Sokolow-Lyon criteria of ECG among subjects with essential HTN, with 95% confidence interval and 5% absolute precision.[14]

3.2. Sampling method

Simple random sampling method using lottery method was used for the selection of days for data collection. Similar procedure was repeated every week Consecutive patients attending on the selected days were included till the sample size for the study was achieved.

Subjects of either sex, aged ≥ 60 years, who have been diagnosed with essential or primary HTN, irrespective of duration of HTN, type of treatment receiving and those who have given consent were included in the study. Those having secondary HTN with previous ischemic heart disease, congenital heart disease, valvular heart disease, primary lung disease and those who have not given consent were excluded. They were recruited after taking informed written consent**.**

3.3. Data collection and statistical analysis

Data was collected by using a pretested and interviewer administered questionnaire. Then they were subjected to detailed history taking, through examinations and investigations. Chest X-ray postero-anterior (PA) view was performed on each subject. A cardiothoracic ratio (CTR) >0.5, was considered as LVH. Subjects having CTR >0.5 due to causes other than essential HTN were excluded from the study. X-ray findings were interpreted by consultant radiologist of the institution. The diagnosis of LVH was made by Sokolow–Lyon index of ECG (S wave in V1 + R wave in V5/V6 >35mm was considered as LVH irrespective of sex). ECG had been taken as reference for comparison due to unavailability of Echo and CMR.

Collected data was tabulated, analyzed and interpret by SPSS 20.0. Continuous variables were described by mean and standard deviation (SD) and categorical variables was presented as percentages / proportion. Appropriate statistical tests - independent t-test, ANOVA test, Chi square test, odds ratio and fisher exact test were applied accordingly. 95% confidence intervals (CI) and p-value (<0.05) were considered significant.

3.4. Ethics statement

Ethical approval was obtained from the Institutional Ethical Committee of Bankura Sammilani Medical College and hospital, Bankura, West Bengal (Memo No. BSMC/Aca/ 792).

3.5. Operational definitions

1. *Elderly*- Government of India adopted 'National Policy on Older Persons' in January, 1999. The policy defines 'senior citizen' or 'elderly' as a person who is of age 60 years or above.[16]
2. *Hypertension*- The presence of a persistent elevated SBP ≥ 140 mmHg and/or diastolic DBP ≥90mmHg, and/or the use of anti-hypertensive drugs and/or past medical history of hypertension.[8]

4. Results

4.1. Socio demographic profile

The study sample comprised (59, 59%) males and (41, 41%) females. Mean age was 66.10 (±7.69) years. 41 (41%) subjects were hypertensive from 6-10 years and 31 (31%) since >10 years. 58, 58% subjects were living in joint families. 73 (73%) belong to middle class socioeconomic status. Almost two third (67%) of the subjects were unemployed and had sedentary lifestyle. Out of 59 male 43 (72.9%) were smoker and 37 (62.7%) alcoholic. Female

Table 1: ECG findings

ECG findings (Multiple responses)	Frequency (n)	Percentage (%)
Sinus tachycardia	11	11.0
Atrial fibrillation	6	6.0
Left axis deviation	25	25.0
Left anterior fascicular block	14	14.0
Left posterior fascicular block	2	2.0
Bi-fascicular block	2	2.0
Left bundle branch block	10	10.0
Right bundle branch block	8	8.0
Left atrial enlargement	28	28.0
Right atrial enlargement	4	4.0
ST-T wave changes	37	37.0
Strain pattern	19	19.0

Table 2: Socio demographic determinants of left ventricular hypertrophy

Variable		Left ventricular hypertrophy (Present) (n, %)			
		Chest x-ray (n=29)	Statistics (p value)	Sokolow Lyon criteria (ECG) (n=32)	Statistics (p value)
Age (yrs.)	Mean (±SD)	69.59 (±8.55)	P*<0.05, S	68.47 (±7.53)	*P<0.05, S
Sex	Male	12 (20.3)	P#<0.05, S	17 (28.8)	P#>0.05, NS
	Female	17 (41.5)		15 (36.6)	
Duration of hypertension (yrs.)	< 1	0 (0.0)	P$<0.05, S	1 (11.1)	P$<0.05, S
	1-5	0 (0.0)		0 (0.0)	
	6-10	12 (29.3)		16 (39.0)	
	>10	17 (54.8)		15 (48.4)	
Smoking	Present	11 (25.6)	P#>0.05, NS	15 (34.9)	P#>0.05, NS
	Absent	1 (6.2)		2 (12.5)	
Alcohol consumption	Present	10 (27)	P#<0.05, S	15 (40.5)	P#>0.05, NS
	Absent	2 (9.1)		2 (9.1)	
Family history of hypertension	Present	11 (28.2)	P#>0.05, NS	17 (43.6)	P#>0.05, NS
	Absent	18 (29.5)		15 (24.6)	

(S- Significant, NS-Non-significant, *Independent t-test, # Chi square test, $ Fisher Exact test)

subjects found to be neither smoker nor alcoholic.

4.2. Clinical profile

Most (53, 53%) of the study subject came for follow up. Common symptom in study subjects were weakness (17, 17%), headache (16, 16%), pedal oedema (12, 12%), awareness of their own heart beat (11, 11%), followed by breathlessness (10, 10%). Blurring of vision was present in 40 subjects.

Mean systolic, diastolic and pulse pressure was 164.26 (±19.6), 98.87 (±8.6) and 65.39 (±15.6) mmHg respectively. Mean blood urea nitrogen was 21.46 (±9.67) mg/dl. Mean serum creatinine was 1.45 mg/dl. High fasting blood sugar (FBS) was detected in 34 (34%) and 42 (42%) had deranged lipid profile.

Clinical finding of LVH were present in 23 (23%) subjects. Overall 29 (29%) and 32 (32%) subjects had LVH by chest x-ray and Sokolow Lyon criteria respectively. Significant positive correlation between "CTR and Sokolow Lyon criteria" ($r = 0.321$, $p = 0.001$) was present.

Table 1 describes ECG findings in study subjects. ST-T wave changes were present in ECG of 37% subjects. Strain pattern was observed in 19, 19%. Other findings included left atrial enlargement 28 (28%), left axis deviation 25 (25%), left axis deviation with fascicular block 16 (16%), sinus tachycardia 11% and right atrial enlargement 4 (4%). Six patients had atrial fibrillation**.**

4.3. Sociodemographic determinants of left ventricular hypertrophy

Subjects with LVH were significantly older as compared to those without LVH as observed by chest x-ray and ECG-LVH. Significant higher proportion of female had LVH as observed by chest x-ray. As duration of hypertension increases, chances of LVH increase too. Duration of hypertension and alcohol consumption remained significantly associated with ECG-LVH. Smoking and family history of hypertension was non-significantly associated with LVH (Table 2).

Table 3: Clinical determinants of left ventricular hypertrophy

Variable		Left ventricular hypertrophy (Present) (n, %)			
		Chest x-ray (n=29)	Statistics (p value)	Sokolow Lyon criteria (ECG) (n=32)	Statistics (p value)
Blood pressure (mmHg)	SBP (±SD)	165.03 (±17.43)	P*>0.05, NS	167.63 (±20.75)	P*>0.05, NS
	DBP (±SD)	98.97 (±7.63)		101.06 (±6.87)	
Pulse pressure (mmHg)	Mean (±SD)	66.07 (±16.29)	P*>0.05, NS	66.56 (±17.69)	P*>0.05, NS
Body mass index (kg/m2)	Normal	0.454 (±0.033)	F= 0.336, p§ = 0.799, NS	30.94 (±6.76)	F= 5.335, p§ = 0.002,
	Over-weight	0.484 (±0.057)		30.02 (±6.06)	
	Obese	0.501 (±0.074)		30.82 (±5.29)	
	Morbid obese	0.458 (±0.055)		30.85 (±4.04)	
Blood urea nitrogen (mg %)	Mean (±SD)	25.74 (±7.25)	P*<0.05, S	26.35 (±9.27)	P*<0.05, S
Serum creatinine (mg %)	Mean (±SD)	1.71 (±0.78)	P*<0.05, S	1.63 (±0.73)	P*>0.05, NS
Serum uric acid (mg/dl)	Raised	15 (46.9)	P#<0.05, S	14 (43.8)	P#>0.05, NS
	Normal	14 (20.6)		18 (26.5)	
Micro-albuminuria (mg/dl)	Present	15 (42.9)	P#<0.05, S	15 (42.9)	P#>0.05, NS
	Absent	14 (21.5)		17 (26.2)	
Fasting blood sugar (mg/dl)	High	15 (44.1)	OR=2.9 CI=(1.19-7.19)	14 (41.2)	OR=1.87 CI=(0.78-4.46)
	Normal	14 (21.2)		18 (27.3)	
Dyslipidaemia	Present	18 (42.9)	OR=3.2 CI=(1.3-7.8)	20 (47.6)	OR = 3.48 CI =(1.4-8.3)
	Absent	11 (19)		12 (20.7)	

(S-Significant, NS-Non-significant, *Independent t-test, # Chi square test, §ANOVA, OR- crude odds ratio, CI-Confidence interval)

4.4. Clinical determinants of left ventricular hypertrophy

Subjects with LVH were having non-significantly higher mean blood pressures and mean pulse pressure as compared to those without LVH. Subjects with LVH had significantly higher blood urea nitrogen levels than those without LVH. Albuminuria was significantly more frequent in patients with LVH as detected by CXR. Fasting Blood sugar and dyslipidaemia was associated with greater odds of developing LVH (Table 3).

5. Discussion

The study comprised 59% males and mean age 66.10 (±7.69) years. 41% subjects were hypertensive from 6-10 years, the prevalence of LVH was 29 and 32% by CTR (>0.05) CXR and Sokolow-Lyon criterion of ECG respectively. Similarly many studies reported cardiomegaly on the basis of elevated CTR in chest x- ray ranging from 11% to 25% subjects.[9,17,18] These finding are consistent with many previous studies with prevalence of LVH in hypertensive patients varies from 4 to 92% based on the population studied and ECG criteria used.[15,19–24]

Subjects with left ventricular hypertrophy (LVH) were significantly older (p<0.05) as compared to those without LVH in this study. These findings are consistent with previous studies[25,26] whereas Emmanuel and Kofi found non-significant difference between ECG-LVH and age.[23,27] Present study revealed that females were significantly more likely to develop LVH like other studies.[27–30] Duration of hypertension was found to be significantly associated with LVH in present study, which is consistent with most studies, reported that as the duration of hypertension increases, the chances of LVH increase too.[22,26,31–33] A significant association between LVH with smoking and alcohol consumption was found concurrent with other studies.[27,34–36]

Other studies also reported that as severity or grading of blood pressure increases prevalence of LVH increases too.[27,34,37] Subjects with LVH were having non-significantly higher mean pulse pressures as compared to those without LVH like study done by Kofi and Emmanuel but contrary to Halilu et al.[25,27] Subjects with ECG-LVH had significantly higher body mass index than those without LVH like other studies.[38–41] Present study revealed that subjects with LVH had higher mean blood urea nitrogen, mean serum creatinine, micro-albuminuria and serum uric acid as compared to those without LVH.[27,39,42,43] High fasting blood sugar and dyslipidemia was significantly (P<0.05) associated with greater odds of developing LVH in chest x ray LVH like present study.[39]

ST-T-wave changes and Strain pattern was present in 37% and 19 (19%) subjects respectively. It is associated with adverse CV risk factors. Salles et al reported strain pattern in 23% subjects.[44] Emmanuel & Kofi reported ST-T-wave changes in 30% subjects.[23]

6. Conclusion

LVH is a common pre-clinical cardiovascular complication of chronic hypertension. Increasing age, sex, family history, duration and severity of HTN, smoking, alcohol consumption, BP, PP, BMI, blood urea nitrogen, serum creatinine, albuminuria, serum uric acid, fasting blood sugar and dyslipidaemia appear to be the independent determinants of LVH. The chest radiograph (x-ray) in conjunction with the ECG may provide important information on the presence of LVH. Liberal use of these cost effective tools in hypertensive patients (with special emphasis on high risk patients) could be useful in early diagnosis of LVH and treatment in limited resources setups, where gold standard diagnostic tests like Echo and CMR are not available.

7. Limitations

Cross sectional study design don't provide causal association and inferences. Cohort or some other long duration follow up studies will explore more about consequences of chronic BP in the elderly. Present study had low sample size so further studies with large sample size needed. Adjusted analysis is needed to ascertain correlation between CV outcome / changes with associated risk factors.

8. Recommendation

"Since hypertension is an avoidable and treatable risk factor, public release of Information, education and counseling services to create more awareness about controlling BP and other risk factors, screening, monitoring, adequate and timely treatment with a special attention on treatment compliance should be emphasized".

In low as well as limited resource settings, attempts should be made to detect hypertensive patients early within the community and manage them appropriately before irreversible organ damage and complications set in. The methods used in this study are simple and adaptable at the primary as well as secondary healthcare level for planning prevention and intervention programmes.

9. Source of Funding

None

10. Conflict of Interest

None.

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Author biography

Bijay Prakash Yadav, Resident, DM Cardiology

Poonam Kushwaha, Assistant Professor https://orcid.org/0000-0002-2762-4492.

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