

CHANGES IN CARDIAC STATUS DUE TO ISOLATED SYSTOLIC HYPERTENSION BY NON- INVASIVE STUDIES

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ABSTRACT: AIM: It was thought previously that morbidity and mortality are directly related to both Systolic and Diastolic blood pressure. However evidences from different studies suggest that systolic hypertension deserves more importance especially due to its profound effect on cardiovascular disease progression. Isolated systolic hypertension (ISH) has now increased amongst the elderly population due to increased longevity. **METHOD:** Total 240 patients of 65 – 89 years age group were taken as study group at the out-patient and in-door department of CNMC Kolkata and NBMC, Siliguri. All patients were divided into three groups based on systolic blood pressure: Gr A=SBP-140—159 mmHg, Gr B=SBP-160-179 mmHg & Gr C=SBP>180 mmHg with each group having age and sex matched 100 healthy normotensive control subjects. History, Clinical examination, ECG and Echocardiographic studies were done in the selected patients. Sophisticated tests were not done due to nonavailability. **RESULTS:** Major Electrocardiogram changes are left atrial enlargement, left ventricular hypertrophy with systolic strain, Inferior wall ischemia, both bundle branch blocks, bifascicular block, left axis deviation. Other minor changes were: antero- septal ischemia, septal wall ischemia, lateral wall ischemia, right axis deviation, arrhythmia, and low voltage were also noted. Echocardiography in 2-D and M-Mode and Echo-Doppler assessment showed increased Intraventricular septal thickness (IVST), Left ventricular posterior wall Thickness (LVPWT) and Left ventricular mass index were the major changes. Left ventricular functional abnormality like diastolic dysfunction was another significant abnormality. **CONCLUSION:** Different anatomical & functional changes in ISH are more prevalent in higher SBP group, and strong risk factor for future catastrophic cardiac events. It is an independent risk factor for CVS morbidity and mortality. Early therapeutic intervention along with life style modification therefore can prevent long term CVS complications.

INTRODUCTION: Isolated systolic hypertension (ISH) is a common form of hypertension in elderly person of both sex and it affects 2/3rd of all individuals of hypertension between the ages of 65-89 years¹. During the recent decades the importance of perceiving ISH has changed from a relatively benign condition to major cardiovascular risk factor and more recent data from Framingham study reinforces the prognostic significance of raised SBP and wide pulse pressure as independent risk factor². According to JNC 7th report in person older than 50 years, systolic BP>140 is much more important CVS risk factor than diastolic BP.

ISH is also a common antecedent of heart failure, kidney damage, blindness and other conditions. Heart failure may be due to LVH with resulting diastolic dysfunction with or without concomitant systolic dysfunction or myocardial infarction⁴. Though it was thought previously that morbidity and mortality from hypertension are directly related to both SBP and DBP, it is now

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evident that systolic hypertension deserves more concern and that is why interest in ISH in the elderly has increased in the last few years.

MATERIAL & METHODS: 240 cases of ISH with age and sex matched 100 cases healthy control subjects were selected for this study. All patients went thorough:

- 1) History takings, clinical examination including B.P. measurement(standard method) and any bruit in abdomen.
- 2) Chest X-ray PA and lateral view.
- 3) Bedside routine blood tests, relevant investigations like, Urea, Creatine, LFT, Lipid profile, electrolytes are done in every case.
- 4) Urinalysis
- 5) USG abdomen to see Kidney size, corticomedullary differentiation.
- 6) 12 lead ECG both resting and exercise
- 7) Echocardiography, 2D, M-mode and Doppler study.

Inclusion Criteria	Exclusion Criteria
SBP > 140 mmHg and DBP < 90 mmHg.	Obvious Secondary causes.
Age: 65-89 years.	Subjects who were not receiving antihypertensive therapy

Data Collection and Categorization were done according to the statistical software application. In this present study various 'Parametric test' like T test and 'Non parametric test' like Chi Square test, was done accordingly using the statistical software IBM-SPSS ver.16.Chicago. All the statistical significance tests were done assuming Level of Significance (P Value) less than 0.05 or 95% confidence intervals.

RESULTS AND ANALYSIS: Distribution of B.P. in the subjects studied showed a wide range of S.B.P. (140 -230 mmHg.) with a mean 176.72 mmHg, whereas DBP was in the range of 70-88 mmHg. (Mean 77.24 mmHg.) Mean SBP and DBP in control group being 124.6 mmHg. and 82.4 mmHg. respectively.

Mean age of the study subjects were 73.04 years and 70.76 years in men and women respectively with a mean body surface area were (BSA) 1.66 and 1.45 in men and women respectively. Mean age of the controls were 74.01 years and 71.26 years in men and women respectively. Most common symptoms among the study group showed blurring of vision in 12%, 26% of Group B & C patients due to cataract, dyspnea on exertion in 14%, 28%, 36% exertion in % of patients Group A, Group B & Group C; dizziness in 4%, 20%, 28% of cases; palpitation 15%, 26%, & 36% of the same. Easy fatigability, headache, anginal syncope and feature of CCF were also noted in a few percentages of cases.

Chest X-ray showed Cardiomegaly (CTR > 0.5) in 12%, 25%, 34% of Group A, Group B & Group C patients and 6% in control group. Associated finding included increased pulmonary vasculature in 6%, 10% of Group B & Group C patients Left atrial enlargement 4% 10% of Group B &

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Group C patients; unfolding of aorta 20%, calcification of aortic knuckle (8%) and aortic aneurysm 2% of Group C cases.

Sl. No.	Finding	% of Patient			Control (%)	
		Gr. A	Gr. B	Gr. C		
1	L A enlargement	6	12	22	8	
2	L V hypertrophy	20	32	42	10	
3	S T changes, T wave inversion and Q wave (suggestive of ischemia)	Inferior wall	5	16	20	6
		Infero- lateral wall			4	-
		Antero - septal			6	-
		Septal			6	-
4	T wave inversion	Lateral wall		6	10	4
		Systolic strain pattern	4	26	40	8
5	Bundle Branch Block	Left	12	32	46	-
		Right	2	6		-
		A. V. block	1	2		-
		Bifascicular Block	2	4		-
6	Axis deviation	Left	12	32	46	10
		Right	2	4	6	-
7	Abnormal Q wave	-	-		-	
8	Arrhythmia	6	2	10	4	
9	R. V. H.		2	6	-	
10	Low voltage			3	-	

Table – 1: ECG finding in ISH

ECG showed Left atrial enlargement (LAE), Left ventricular hypertrophy (LVH), lateral wall ischemia, anteroseptal wall ischemia, infero-lateral wall and septal wall ischemia. Other notable abnormalities were systolic strain, LBBB, RBBB, LAD, RAD, Arrhythmia, low voltage, strain pattern and nonspecific ST segment depression. [Fig. 1].

Findings	% Subject			%Control
	Group A	Group B	Group C	
L.A. diameter > 4cm	8	18	32	8
I.V.S.T. (d) > 1.1 cm	24	46	68	4
L.V. PWT (d) > 1.1 cm	20	42	66	5
I.V.S.T: L.V. PWT = > 1.3	16	20	42	4
L.V.M Index (gm./ m2)				
Male > 135 gm./m2	30	56	70	8
Female > 111 gm./ m2	36	68	80	12

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L.V. Functional Abnormality				
E. < A	42	64	78	16
E/A between 1-2		8	12	
E >2		2	4	
Pattern of Diastolic Dysfunction				
Delayed relaxation	28	46	62	8
Pseudonormalization			10	4
Restrictive filling			4	
IVRT > 100 msec	31	62		
IVST + LVPWT > 2.5 cm	18	36		

Table – 2: Echocardiographic finding in ISH

Routine Echocardiography was performed in all our patients. Left ventricular dimensions, both systolic and diastolic functional assessment were recorded in all patients. Anatomical abnormalities in IVS, LVPWT and Septal wall detected in this study.[Fig. -2 and 3]. Overall diastolic dysfunction was noted in a significant number of cases.

Abnormal Parameters	% detected
Increased IVST	70
LVMI (gm. / m ²)	66
Diastolic dysfunction (E < A)	64
Increased LVPWT	62
Increased IVRT	62
	26

Table 3: Echo – detected L. V. abnormalities in order of frequency

Echocardiographic analysis revealed various abnormalities in patients of ISH which were significantly greater than those of control. Functional abnormality especially diastolic dysfunctions were frequent in these subjects than in control group.[Fig. 3].

DISCUSSION: From different studies it is well established that ISH is more common in people older than 60 years and raised SBP and wide pulse pressure are independent cardiovascular risk factor. It alters LV mass, LV geometric pattern, systolic and diastolic functions. Dyspnea on exertion a prominent symptom of LV dysfunction, was noted in 14%, 28%, 36 % exertion in of patients Group A, Group B & Group C patients; with features of CHF in 6% and 10% of Group B & C patients, anginal pain in 8%, 10%, 30% of Group A, Group B & Group C subjects respectively and majority showed ECG evidence of Inferior and inferolateral wall ischemia. A study from Chandigarh reported hypertension as a common coronary risk factor (14.5%)⁵. A strong association of CAD with SBP was found in various previous study^{6,7}. Considering clinical features LV enlargement was detected by chest X-ray (CTR > 0.5) in 12%, 25%, 34% of Group A, Group B & Group C patients while echocardiography detected LVH was 36%, 68%, 80% of Group A, Group B & Group C female patients; and 30%, 58%, 70% of the same group male patients respectively. In one study by Savage et al⁸, LV enlargement

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was detected in 7% of hypertensive subjects in x-ray chest PA view while echocardiography detected LVH in 67% cases. Comparing our study with this study Echo-LVH was nearly same but variability in radiologic finding can in part be explained by differences in sample size, age distribution, systolic BP level, associated IHD etc. Increased pulmonary vascularity in chest x-ray 6% & 10% in Group B & Group C patients respectively possibly due to presence of heart failure cases in this study dysfunction.

Significant ECG abnormality showed LAE in 6%, 12%, & 22% of patients Group A, Group B & Group C cases (based on Tarazi R.C. et al criteria⁹. LA enlargement may be the reflection of diastolic dysfunction. Frequency of electrocardiographic LVH in 20%, 32%, and 42% of Group A, Group B & Group C case (various criteria used in this study were Sokolow Lyon, cornel voltage and Estes scoring criteria) whereas echocardiographically determined LVH echocardiography detected LVH was 36%, 68%, 80% of Group A, Group B & Group C female patients; and 30%, 58%, 70% of the same group male patients respectively, a result that was consistent with previous study of Surawicz-B¹⁰ and Pearson A.C. et al¹¹. Abnormalities concerning ischemia of different wall of the myocardium and strain pattern were consistent with Framingham Heart study and SHEP trial, where in people with age group of 65-94 years with SBP > 180 mmHg. had 3-4 fold increased in the risk of CAD compared with those SBP < 120^{12, 13}. (Table-1).

Anatomical and functional cardiac changes in control group were much lower. The abnormal findings in control group were probably due to age related increased incidence of CAD, LVH and not due to ISH but in presence of ISH those values are increased about 3-4 fold which is consistent with Framingham study¹². Echocardiographic findings in hypertensive subjects show changes with increasing age and Body surface area (BSA) similar in direction and degree to that seen in normotensive subjects⁸. The magnitude of these changes suggest that the effect of both age and BSA should be accounted for in any attempt to assess the effect of hypertension on Echocardiographic measurements⁸, this is accomplished in this study. Echocardiographic parameters were used to assess both anatomic and functional abnormalities of heart.

One significant anatomic abnormality was Mean LA enlargement of 3.37 cm (range 2.7 – 4.7 cm) showing slightly higher mean value than that of control group 3.08 cm. However LAE > 4 cm was detected in 8%, 18%, 32% of Group A Group B & Group C cases and 8% in control group. Savage et al⁹ found LAE in 5% of hypertensive subjects but in their study hypertensive subjects were younger than our study and this effect of ISH in relation to duration was shorter in this study.

❖ Major Anatomic abnormalities studied were -

- a. IVST diameter > 1.1 cm in 24%, 46%, 68% of Group A Group B & Group C study cases but only 4% cases of control group. (P < 0.05, z value = 8.62.)
- b. LVPWT – changes in LVPWT > 1.1 cm were noted in 20%, 42%, 66% of Group A Group B & Group C case and only in 4% of control group. (Z value = 8.621 and P < 0.05)
- c. LVH or LVMI (gm./m²) – Most important changes noted were LVH and LVMI (LVH defined¹⁴ by LVMI > 135 gm./m² in male and > 111.9 gm./m² in female) was detected in 36%, 68%, 80% of Group A, Group B & Group C female patients; and 30%, 58%, 70% of the same group male patients respectively. Whereas in control group it was 8% and 12% respectively.
[In male: SD (E) = 9.615, mean difference = 20.33, Z variate > 2, P < 0.05. In female: SD (E) = 7.1, mean difference = 32.7 standard variate (Z) = 4.6, P < 0.05.]

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This result of this study had given similar results like that of other studies e.g. Laver M.S, et al in Framingham Heart study 1991, (Hypertension is an establishment determinant and precursor of LVH and LVM),¹⁵ Misseri FH, 1996 (Association of SBP with LVH and LVM), Kar A.K. et al, Savage et al (structural abnormality of heart in 61 % of hypertensive patient).

Based on gender specific criteria echo-LVH was found to be more frequent in female patients than males & in control group also a higher frequency of LVH was noted. The reason for the discrepancies of LVH between men and women is not clear. However it may be due to selective reduction in physical activity among men with hypertension, a substantial prevalence of clinically apparent heart disease associated with mild LVH among apparently normal males or a greater propensity of women to develop marked concentric LVH in response to hypertension for as yet undefined reason^{16,17}.

In this study we have also got septal hypertrophy (IVST: PWT) > 1.3 in Group B (6%) & Group C (14%) cases with increased LV mass which is consistent with previous study report. (Savage et al⁸ mean IVST, LVPWT, LVMI for ISH patient were significantly higher than the control group.

❖ Major Functional Assessment –

1. Systolic function – Ejection fraction (EF) and Fractional shortening (FS) of study subjects were nearly same of that control group. Mean EF was 65.83% and mean FS was 35.42. Only two subjects with reduced EF (< 50%) showed systolic dysfunction. Though mean FS (35.42%) was nearly close to that of control, a significant number showed reduced FS (<34%).
2. Diastolic function – as assessed by decreased E- velocity and enhanced A-velocity with E /A <1 was noted in 42%, 64% 78% Group A, Group B & Group C (P < 0.05) but only in 16% of control showed similar diastolic dysfunction. Almost all patients except a few (who showed diastolic dysfunction) had increased LV mass determined by echocardiography. Thus LVH with LV filling abnormality are very common in subjects with ISH, results being consistent with Person A –C et al¹¹.
3. Another important parameter IVRT increased in 8% 42% 60% of Group B & Group C cases against 18% of control subjects which was statistically significant (Z Variate = 2.72, P < 0.05). Different pattern of diastolic dysfunctions assessed were:
 - a) Delayed relaxation pattern - (E < A, IVRT > 100 msec and tdec 220 msec.) found in 28%, 46%, 52% of Group A, Group B & Group C cases but only 8 % in control group (SE (d) = 4.49 mean difference = 12.24, Z= 2.72, P < 0.05).
 - b) Pseudo normalization pattern – (E / A = 1 -2 tdec = 150 -200 msec; IVRT = 60 -100 msec) in 10% of Group C cases.
 - c) Restrictive filling pattern – (E /A > 2, tdec < 150 msec, IVRT < 60 msec.) seen in 4% of Group cases. 4% of control group showed pseudo normalization pattern but none showed restrictive pattern. Restrictive filling pattern indicates more severe diastolic dysfunction and pulmonary congestion. An Edec time (tdec) < 150 msec. indicates a stiff ventricle and poor prognosis. [Table no. -3].

CONCLUSION: Isolated systolic Hypertension is a common association with elderly people and an independent risk factor for cardiovascular disease and its prognosis. A good relationship was noted between anatomical & functional abnormality along with the level of systolic pressure and it may

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contribute to the decreased exercise capacity and subendocardial ischemia specially during exercise due to lower coronary reserve and increase O₂ demand. Increased LV mass with LV filling abnormality is a common consequence of ISH which occurs more often in women than in men and is considered to be an important risk factor for sudden death, myocardial ischemia, ventricular arrhythmia and heart failure. Thus it constitutes an high risk sign rather than a benign adaptive process, emphasizing the importance of early recognition and timely initiation of antihypertensive therapy to prevent complications. In a country like ours where all the facilities are not available, proper selection of patients of ISH and utilizing minimum available gazettes can go a long way in initiating appropriate in time therapy for delaying, retarding, and preventing cardiovascular morbidity and mortality in course of the disease progression due to the long term effect of ISH causing various cardiac complications.

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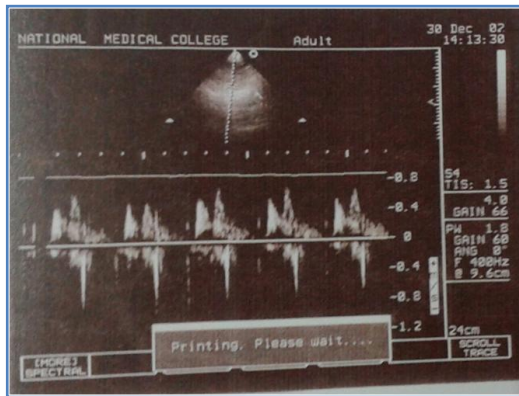


FIG. 1: ECHO DOPPLTR STUDY SHOWING ALTER E & A RATIO

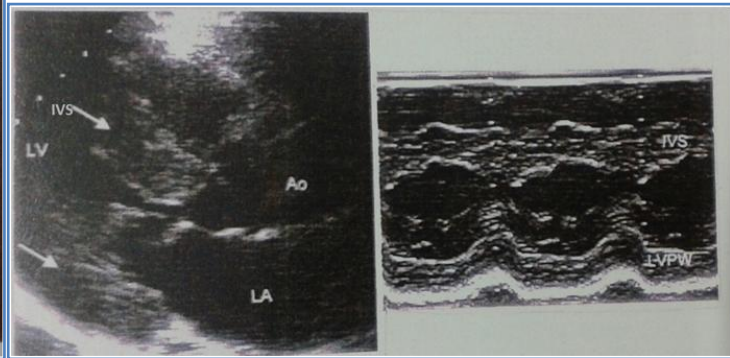


FIG-2. 2D & M-Mode echo-showing increased IVST and LVPWT

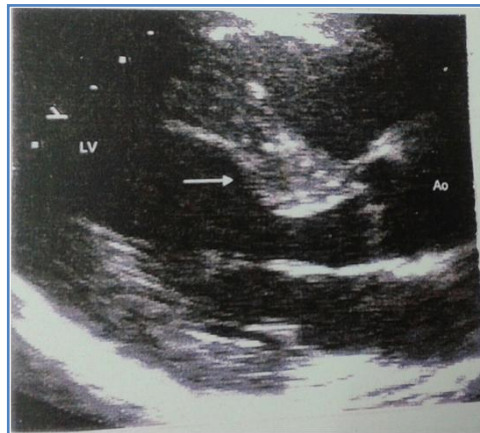


FIG-3. 2D & M-Mode echo-showing increased IVST

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