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Cardiac changes in isolated systolic hypertension in elderly with special reference to electrocardiography and echocardiography study

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Abstract

Background&Objectives: Isolated systolic hypertension is a raised systolic blood pressure with normal diastolic blood pressure. As age progresses, more persons will be hypertensive, a disease which is definitely most prevalent remediable risk factor for cardiovascular diseases. Isolated systolic hypertension is the commonest variant of increased blood pressure in the elderly.At the same time, awareness of hypertension, its risk factors, and complications is very poor. Most of these elderly patients are asymptomatic, and hence remain undiagnosed for a very long time and finally present with irreversible end-organ complications. Most common organ to be involved is heart. Hence the present study is undertaken to study the cardiac status and associated risk factors of elderly patients with isolated systolic hypertension. **Methods:** An observational (cross-sectional) study undertaken on patients attending the outpatient department and inpatients of C.R.G.H hospital attached to R.D.Gardi Medical College , Ujjain, during the period of one and half year between November 2017 and May 2019.Patients more than 60 years of age with isolated systolic hypertension were included in the study. Detailed evaluation of patients comprising of detailed clinical history, thorough physical examination with relevant basic investigations was done.Standing blood pressure was recorded and at least 2 measurements on each of 2 or more visits and mean of the three recordings were taken.Routine investigations like Complete blood count (CBC), Urine-albumin, Fasting and post-prandial blood sugars (FBS, PPBS), Glycosylated haemoglobin, Blood urea, Serum creatinine, Lipid profile were done. ECG and 2-D guided M-mode echocardiography was done and analysed for LVH and LVMI respectively. The statistical software namely SPSS 11.0 and systat8.0 were used for the analysis of the data. Chi square and fisher exact test were used to find the significance of proportions of risk factors between increased LVMI and normal LVMI.**Results:** A total of 120 patients, aged more than or equal to 60 years (elderly) who were newly diagnosed with isolated systolic hypertension (SBP >140,DBP < 90) were selected.The mean age of all the patients was 73.31+/-6.62. 64.2% of the study group were males, while 35.8%were females.The commonest ECG finding was left ventricular hypertrophy. 35% were positive by Sokolw-Lyon criteria and 26.7% were positive as per Romhilt- Estees criteria. Increased LVMI (>131 gm/m2 in males and >100gm/m2 in females) in 48.4%. Increased LV volume (>90ml/m2) in 17.5% of patients. Regional wall motion abnormality in 25.8% of the patients and Reduced ejection fraction in 40.0% of the patients.**Interpretation and Conclusion:** Hypertension in the elderly population is emerging as a major public health problem in our country. ISH contributes to significant morbidity and mortality as it is associated with complication and target organ damage.Increased BMI, waist-hip ratio, dyslipidemia and diabetes mellitus are most common risk factors associated with isolated systolic hypertension.ISH associated with risk factors has definite effect on heart in terms of Left ventricular hypertrophy and increased LVMI.

Keywords: Hypertension,blood pressure

Introduction

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Isolated systolic hypertension is a raised systolic blood pressure with normal diastolic blood pressure[1].As age progresses, more persons will be hypertensive, a disease which is definitely most prevalent remediable risk factor for cardiovascular diseases. Isolated systolic hypertension is the commonest variant of increased blood pressure in the elderly[2,3]. With improving health facilities in India, the life expectancy at birth has increased to more than 64 years.

Therefore number of elderly population in India has grossly increased. At the same time, awareness of hypertension, its risk factors, and complications is very poor. Most of these elderly patients are asymptomatic, and hence remain undiagnosed for a very long time and finally present with irreversible end-organ complications[4-6].Most common organ to be involved is heart[7,8]. Hence the present study is undertaken to study the cardiac status and associated risk factors of elderly patients with isolated systolic hypertension. The prevalence of isolated systolic hypertension and its

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cardiovascular sequelae is increasing and therefore makes it uttermost important to study about risk factors, etiology, complication, prevention and treatment.

Material and methods

This was an observational (cross-sectional) study undertaken on patients attending the outpatient department and inpatients of C.R.G.H hospital attached to R.D.Gardi. Medical College , Ujjain, during the period of one and half year between November 2017 and May 2019. A written informed consent from all study subjects was taken. Patients more than 60 years of age with isolated systolic hypertension were included in the study and patients with cardiac diseases (Ischemic heart disease, Rheumatic heart disease), chronic renal failure were excluded. Detailed evaluation of patients comprising of detailed clinical history, thorough physical examination with relevant basic investigations was done. Standard mercury sphygmomanometer properly calibrated and validated instrument with an appropriate sized cuff (cuff bladder encircling at least 80% of the arm) was used. Patients were seated quietly for at least 5 minutes in a chair, with feet on the floor and arm supported at heart level. Standing blood pressure was recorded and at least 2 measurements on each of 2 or more visits and mean of the three recordings were taken. The first appearance of the sound (phase I , korotkoff) is the systolic BP and the disappearance of the sound (phase V) is the diastolic BP. Blood pressure recordings were documented and the staging of ISH was done.Isolated systolic hypertension (ISH) is defined as a systolic blood pressure (SBP) of more than 140 mm Hg with a diastolic blood pressure (DBP) of less than 90 mm Hg[1].

General physical examination, systemic examination, height, weight, waist to hip ratio and Body surface area was calculated using the Dubious formula: BSA $(m^2) = 0.007184$ [weight (kgs)] 0.425x [height (cm)] 0.725.Routine investigations like Complete blood count (CBC), Urine-albumin, Fasting and post-prandial blood sugars (FBS, PPBS), Glycosylated haemoglobin, Blood urea, Serum creatinine, Lipid profile were done. American Diabetes Association criteria for the diagnosis of diabetes mellitus was used. ECG was recorded at 25 mm/sec speed and 10 mm/mv standardization. The following were analysed for LVH : 1. Sokolow– Lyon criteria (SLC): SV1 + RV5 or V6 (whichever is greater) >/= 35 mm Hg and Modified Romhilt– Estees point score system. 2-D guided M-mode echocardiography was done by an experienced echocardiographer on a Hewlett Packard color Doppler machine using 3.5 MHz phased array sector transducer. The echocardiographer was blinded to ECG results. M-mode echocardiographic measurements were obtained using parasternal long axis view, at the mid cavity level as defined by the tip of papillary muscle. The measurements of left ventricular internal dimension (LVIDd), inter-ventricular septal thickness (IVSTd) and posterior wall thickness (LVPWd) were made at the end diastole is defined by the peak of R- wave on a simultaneously recorded ECG. Measurements were done using the ASE convention (standard convention). In ASE convention, the thickness of the endocardial surfaces is excluded from the measurements of LVIDd and include in the measurement of interventricular septum and posterior wall thickness. The mean measurement of three consecutive beats were taken. ASE cube LV mass was calculated by the formula: 1.04 (LVIDd + IVSTd + LVPWD)3 – (LVIDd)3

The statistical software namely SPSS 11.0 and systat 8.0 were used for the analysis of the data and Microsoft word and excel have been used to generate graphs, tables etc. Chi square and fisher exact test were used to find the significance of proportions of risk factors between increased LVMI and normal LVMI. Odds ratio has been used to find the strength of relationship of proportion of risk factors between categories of increased LVMI and normal LVMI and change of stage of BP. The student 't' test has been used to find the significance of mean values of anthropometry between male and female patients. The diagnostic statistics were used to find the diagnostic value of SLC and RES in comparison with ECHO LVMI, which is the gold standard.

Results

This hospital based cross sectional study was conducted on 120 elderly (>60 years) newly diagnosed patients of isolated systolic hypertension. Based upon the systolic blood pressure range, the patients were classified as stage 1 (140-159 mmHg), Stage 2 (160-179 mmHg) and Stage 3 (180 mmHg). ECG and Echocardiography were conducted to assess the cardiac status of the patients.In present study, mean age of all the patients was 73.31±6.62 years whereas mean age of males and females were 74.48±6.67 and 72.21±6.03 years respectively. The present study observed no significant difference in mean age of males and females (p>0.05). The study registered 77 males (64.2%) and 43 females (35.8%). Majority of patients belonged to 66 to 70 years of age group (34.2%) followed by 76 to 80 years of age group (30.8%).
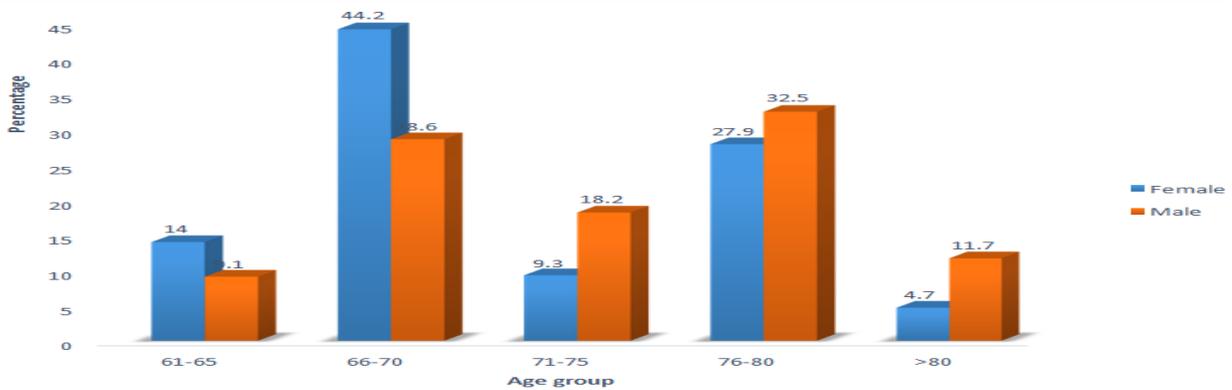
Fig 1:Distribution according to age and gender

In present study, stage 1, 2 and 3 isolated systolic hypertension were observed in 25 (20.83%), 54 (45%) and 41 (34.2%) patients respectively. The mean age of patients in stage 1 was 66.84±3.55 whereas mean age in stage 2 and stage 3 were 73.02±5.16 and 77.63±6.36 years respectively. Test of significance observed a highly statistical difference in mean age between various stages of isolated systolic hypertension i.e. as the age advances, blood pressure also increases significantly(p<0.01).
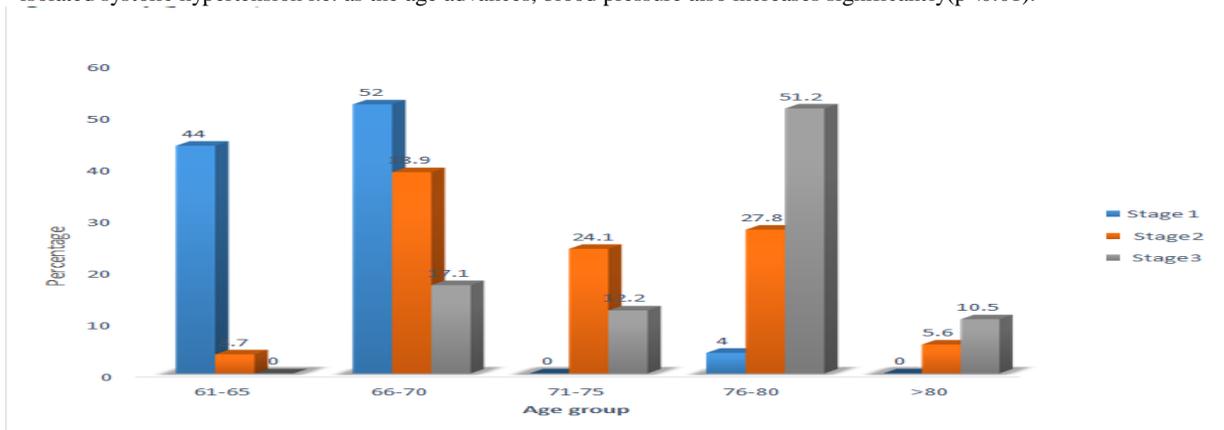

Fig 2: Association of age with stage of blood pressure

The most common risk factor associated with ISH was waist hip ratio (>0.9 in males and >0.8 in females) in 51.7% cases followed by BMI more than 25 and diabetes in 45.8% and 39.2% cases respectively.
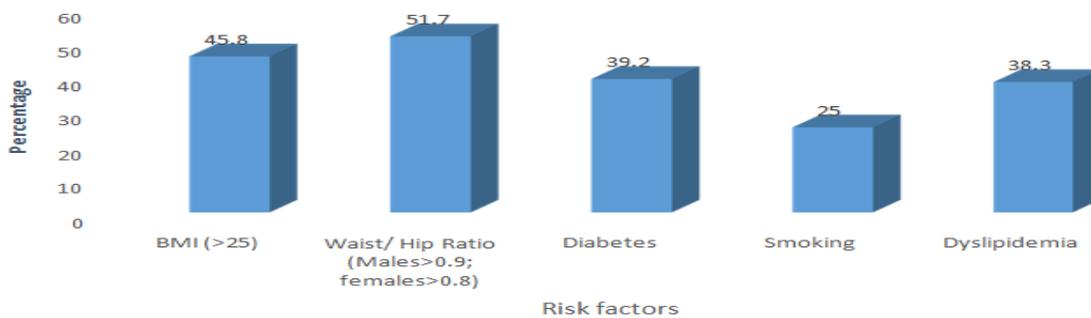

Fig 3:Associated Risk factors

Sokolow- Lyons criteria (SLC) and Romhilt Estees score (RES) were used to assess the left ventricular hypertrophy in ECG. LVH was observed in35% and 26.7% patients by SLC and RES criteria respectively.
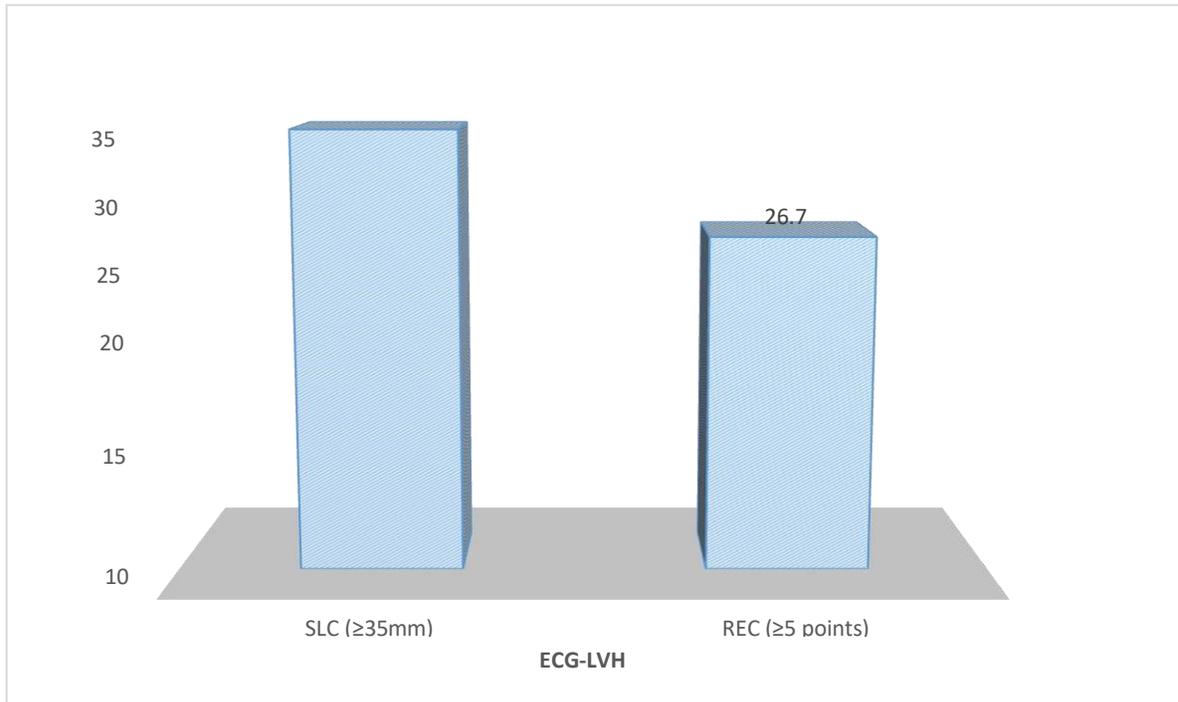

Fig 4:LVH Criteria as per ECG

Most common echocardiographic change observed was increased left ventricular mass index in 48.4%patients and 40% cases with ISH were observed to have reduced ejection fraction

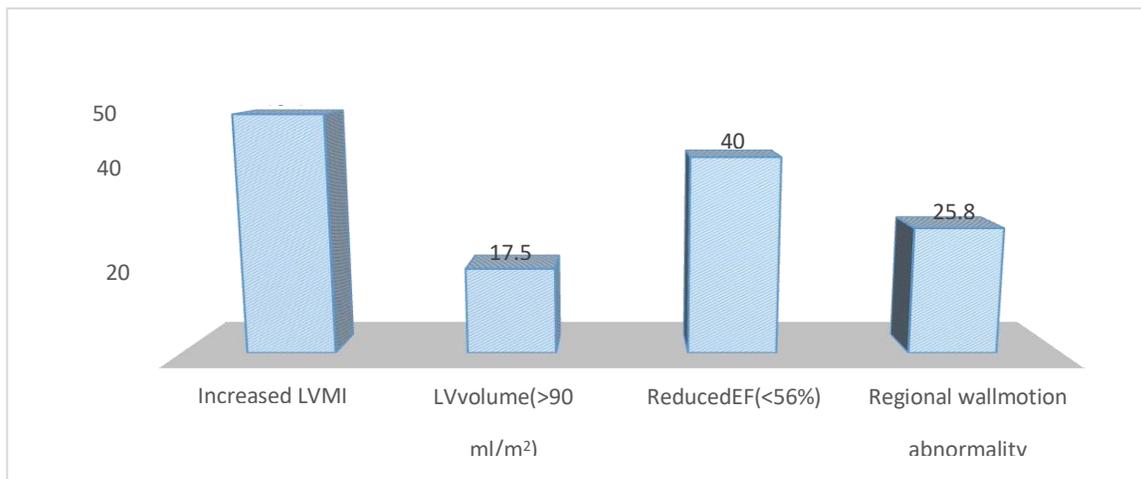**Fig 5:Echocardiographic changes in ISH**

As the stage of hypertension increases, the incidence of LVMI increases. The risk of occurrence of increased LVMI in patients with stage 3 ISH are 3.52 times higher than those with other stages (p<0.01).
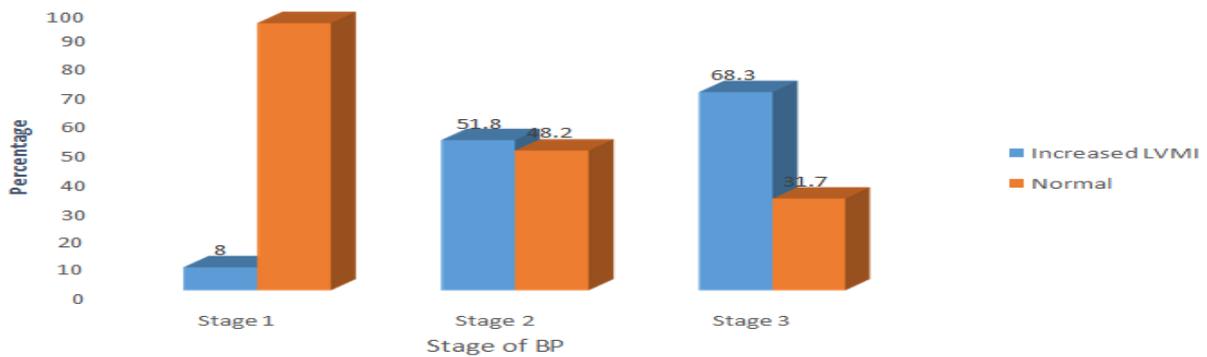
Fig 6:Association of increased LVMI With stage of BP

In present study, diabetes and smoking were the risk factors significantly associated with increased LVMI (p<0.05). The odds of occurrence of increased LVMI were 3.86 and 1.6 times higher amongst diabetics and smokers as compared to nondiabetic and nonsmokers respectively. The odds of occurrence of increased LVMI in patients with increased waist hip ratio was 1.23 times higher as compared with normal waist hip ratio.The sensitivity of SLC was only 50% and specificity was 79% whereas sensitivity and specificity of RES was 43.1% and 88.7% respectively. Positive and negative predictive values were 69% and 62.8% for SLC and 78.1% and 62.5% in RES. Hence SLC and RES criteria were observed to be of low diagnostic value. The level of agreement of echo findings with RES (0.33) and SLC (0.29) as shown by Kappa coefficient were observed to be fair.
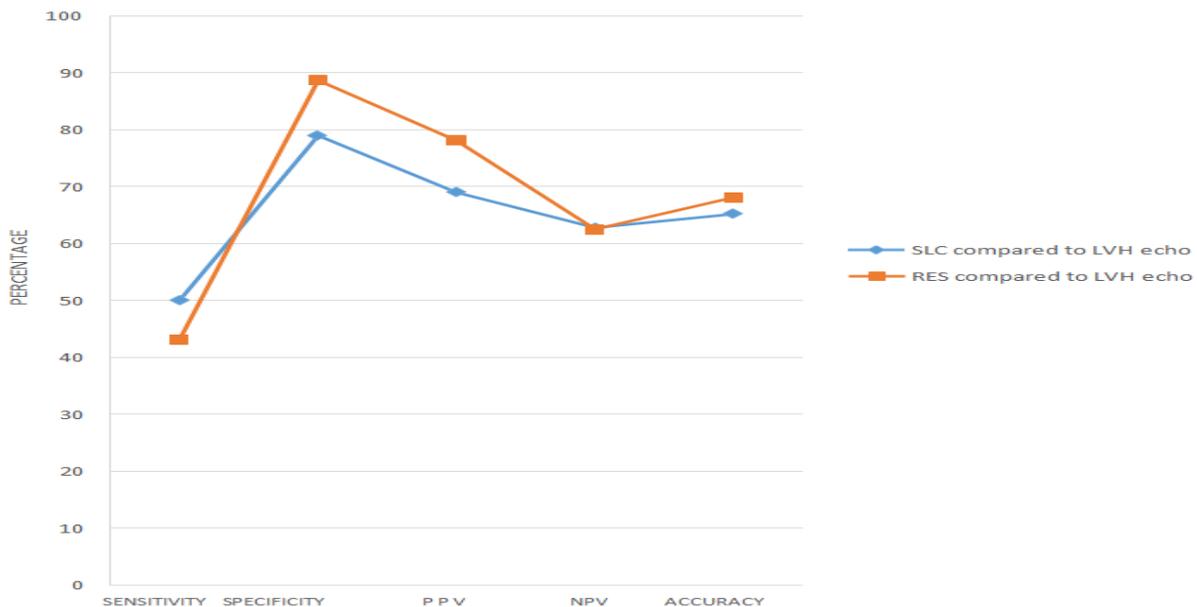

Fig 7: Validity of ECG findings compared to echocardiographic findings

Discussion

Hypertension is present in more than half of all persons over 60 years of age. Majority of hypertensive patients in this age group have isolated systolic hypertension. National high blood pressure education programme working group reported systolic blood pressure as a strong predictor of all cardiovascular events and all cause morbidity and mortality in elderly. Joint national committee on prevention, detection, evaluation and treatment of hypertension reported that in persons older than 50 years, systolic BP of more than 140mm Hg is a much more cardiovascular risk factor than diastolic BP. Studies have also shown that cardiovascular remodeling is

greater in ISH than in diastolic hypertension and that level of systolic BP correlated best with the development of left ventricular hypertrophy. A total of 120 elderly (>/= 60yrs) patients with newly detected isolated systolic hypertension were selected for the study. Almost 80% of the population under study was in 66-80 yrs range. Mean age of patients was 73.31 ± 6.62. Male to female ratio was 1.91:1. Out of this males constituted 64.2% (77 out of 120) and 35.8 % (43 out of 120) were females. However this difference in incidence between males and females was not found to be significant. Comparing this to a study by Dwivedi et al (2000), which showed a male to female ratio of 1.44 : 1 and the mean age of all patients in their study was 67.36 ± 6.23.17 In the Systolic hypertension in elderly programme (SHEP trial) mean age of all patients was 72 yrs and mean blood pressure was 170/77.9 Michael A Colandrea et al found mean age to be 69.7 yrs[18] Thomas kuruvilla et al found the proportion of hypertensive suffering from ISH, increases with age in those more than 70 yrs.1975.6% of men and 82.1% of women with hypertension had ISH. ISH was significantly more in women than in men. In the present study, stage 1,2,3 isolated systolic hypertension were observed in 25 (20.83),54(45) and41(34.2) patients respectively. In the present study, the mean age of all patients with stage 1 BP was 66.84+/- 3.55yrs. Of Stage 2 patients was 73.02 +/- 5.16yrs, and of stage 3 BP was 77.63 +/-6.36yrs. Statistical analyses of the above data revealed that as age increases the severity (stage) of blood pressure also increases significantly with p < 0.001. Messerli FH et al, Anerya et al found that prevalence of ISH increases with age from about 5% in patients at 60 yrs to 25% of those aged 80 yrs. Rocha et al found that there has been increase in ISH from 44-57% in the age group from 60-80yrs.20 42.8% of the patients had BMI > 25. 51.7% of the patients had waist-hip ratio more than 0.9 in males and 0.8 in females. 39.2% of the patients had diabetes mellitus and dyslipidemia in 38.3%. Dwivedi S et al found that 31.41% of patients had diabetes mellitus.17The highest prevalence rates of diabetes (50%) and hypertension (72.6%) were found among the oldest patients (>60 years of age) and in those with the highest body mass indexes (>50).11 The present observation was supported by Midha et al, Gupta et al, Xu et al and Kashiwal Cherukuri. 12,13,14 In our study, prevalence of ISH was found high among both males and females (22.8%) who had higher waist-hip ratio compared to normal. N.C hazarika et al26 found that age, BMI, waist-hip ratio are associated significant risk factors. However smoking is negatively associated. 38.3% of the patients had dyslipidemia. Among these patients 19% of the patients had isolated high triglycerides (>150 mg/dl). 29% of the patients had isolated low HDLC (100mg/dl). In the study by P. Malhotra et al found that prevalence of dyslipidemia was 46.8%. Prevalence of isolated high HDLC was 23.7% and high triglycerides 18.8%. However the study group consisted of hypertensives of all age groups.21 High total cholesterol, which is the second-leading physiological risk factor for IHD after high BP (Lim and others 2012)[27].

Physiologically, LDL is critical to the generation of atherosclerosis. The commonest ECG finding detected in the present study was that of left ventricular hypertrophy. Sokolow-Lyon criteria positive in 35% patients and Romhilt-Estees criteria positive in 26.7% of the patients. Vrinda et al10 found that LVH was the commonest ECG finding in 36.8% of the patients. Boon D et al found prevalence of silent myocardial ischemia in ISH. In the present study, echocardiographic changes observes were : Increased left ventricular mass index in 48.4% of the patients. Increased left ventricular volume in 17.5% of the patients. Regional wall motion abnormality in 25.8% of the patients. Reduced ejection fraction in 40% of the patients. So, the most common abnormality observed was increased left ventricular mass index, with almost half of the patients under study showing this feature. Lindross M. et al 24 found echocardiographic evidence of LVH even in the general population. Harlen et al.[15] showed the incidence of LVH in ISH. The Systolic Hypertension in Elderly Program (SHEP) trial also showed increased LVH in ISH and also as the predictor of fatal outcome[16]. In the present study, patients with cardiovascular disease risk factors like DM, smoking were positively related with increased LVMI with like DM, smoking were positively related with increased LVMI with p<0.05. Patients with diabetes are 3.86 times more likely to develop increased LVMI. Patients with smoking are 1.6 times more likely to develop increased LVMI. The odds of occurrence of increased LVMI with waist by hip ratio was 1.23. Din FC et al and Frohlich ED et al found diabetes and increased waist to hip ratio to be more significantly associated with increased left ventricular index[22,23]. In the present study it was observed that 8% of the patients with stage 1 BP were having increased LVMI. 51.8% of patients in stage 2 and 68.3% of patients in stage 3 had increased LVMI. Statistical analyses of the data revealed that as the severity (stage) of blood pressure increased , the incidence of increased LVMI also increased significantly.Both Sokolow-Lyon and Romhilt-Estees criteria for diagnosis of LVH are less useful than ECHO scan, which is the gold standard for diagnosis of LVH. In the present study, SLC shows a sensitivity of 50% and specificity of 79%.Whereas RES criteria has sensitivity of 43.1% and a specificity of 88.7%. However RES is better than SLC in terms of accuracy and kappa coefficient of agreement.It has been shown from various studies (Reichek et al)[25] that ECHO determined LVH is highly sensitive and correlated well with postmortem LV- weight (r=0.96). It has been proven by various studies that extraneous factors like female sex (breast tissue), obesity, emphysema (smoking), and IHD–all cause alternation of the voltage and hence decrease the sensitivity. Technical errors like proper placement of the electrodes and reader interpretation should be kept in mind. Low specificity could also be due to increased false positive cases, false positivity could be due to extraneous factors like cachexia, dilated hearts despite a normal LV mass. Hence there is a need for computerised examination of the ECG's, which will improve the accuracy of diagnosis of ECG criteria in

early stages. Also there is a need to develop more sensitive ECG criteria for quick and early diagnosis of LVH. Clinicians should continue to use these ECG criteria (SLC, RES) that are known to have a more reasonable sensitivity for LVH. These criteria should be used especially in clinical patient population in whom specificity of 95% is acceptable.

Conclusion

Hypertension in the elderly population is emerging as a major public health problem in our country. ISH contributes to significant morbidity and mortality as it is associated with complication and target organ damage. Majority of the hypertensive patients in the age group of more than 60yrs (elderly) have isolated systolic hypertension and as age increases, the severity (stage) of blood pressure also increases[2,3] Increased BMI, waist-hip ratio, dyslipidemia and diabetes mellitus are most common risk factors associated with isolated systolic hypertension.ISH associated with risk factors has definite effect on heart in terms of Left ventricular hypertrophy and increased LVMI. It is also observed that as the stage of blood pressure increases, the incidence of increased left ventricular mass index also increases which is a better predictor of morbidity and mortality and significantly associated with all adverse outcomes. It has been shown in this and previous studies that ECG, echocardiography both are useful in determining LVH, and echocardio-graphy being moresensitive and specific [25]. ISH itself is most attributable risk factor for hypertension in elderly and warrants a regular blood pressure control. Several trials have shown clear benefit of treating ISH. Thus, early detection of left ventricular dysfunction and hypertrophy by echocardiography and timely intervention by diet, lifestyle modifications and drugs is an urgent need of hour.

Limitations-The sample size of current study was small.

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