

STUDY OF ECG FINDINGS IN HYPERTENSIVE PATIENTS WHO PRESENTED TO DAE HOSPITAL.

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Abstract: **Background:** Hypertension is a major cause of morbidity and mortality and affects an estimated 1.4 billion people worldwide. Long term consequences of hypertension can include ischemic heart disease, stroke, and end stage renal disease. Various ECG findings in hypertension include left ventricular hypertrophy changes, increased P wave amplitude, and changes in the ST-T segment. Left ventricular hypertrophy can be seen as QRS voltage which is increased in v5 v6 leads – left ventricle leads. Also it is calculated by using sokolow lyon criteria which is adding the amplitude of S wave in v1 or v2 and R wave in V5 or v6 (>35 mm-LVH) and Cornell criteria which shows S wave in avl and R wave in v3. A sum exceeding a certain threshold (e.g., 20 mm in women, 28 mm in men) suggests LVH. P wave amplitude is also seen for hypertensive patients in lead 2 and avl which indicate right atrial enlargement which also indicate pulmonary hypertension. ST depression and T wave inversion, Prolonged QRS duration Prolonged QT interval also can occur. Hence ECG is a pivotal investigation as >5 years of hypertension causes the left ventricular hypertrophy changes in ECG which is used to give an idea for cardiovascular event risk, **STUDY METHODOLOGY AND AIM:** This is a retrospective study done in our institution from March 2025-Feb 2026 of random selection of 100 patients after obtaining ethical clearance and informed consent from all patients who had hypertension and was on medications. In our study we used the most common method of seeing LVH in ECG by Sokolow Lyon criteria. The aim of the study is to correlate structural abnormalities of heart (LVH) **RESULTS** - LVH criteria was found predominantly in men than women which was in line with national and international studies. With duration of hypertension through noninvasive test (ECG) associated with risk factors. Males were most affected with greater than 5 years of hypertension (-49) who were positive for criteria and females (35) had greater than 5 years duration of hypertension with positive criteria. It was also found that 10 males {17%} and 6 females {15%} had positive LVH criteria in ECG even with less than 5 years duration of hypertension which was significantly important. About 24 males >60 years and 16 females >60 years were having associated risk factors. It was also found 22 males and 22 females <60 years also had associated risk factors. **CONCLUSION** - Our study has made ECG (noninvasive) test, a mandatory test for patients with hypertension as a tool for structural assessment of the heart so that early diagnosis and management of hypertension and prevention of mortality due to CAD can be made.

Keywords: Left ventricular hypertrophy, sokolow lyon criteria, cardiovascular disease risk, structural assessment, noninvasive test .

INTRODUCTION

Hypertension is a major cause of morbidity and mortality and affects an estimated 1.4 billion people worldwide. Long term consequences of hypertension can include ischemic heart disease, stroke, and end stage renal disease. Cardiac structural changes from prolonged hypertension can lead to arrhythmia and sudden cardiac death. Managing BP early, even at pre hypertensive levels, may decrease the incidence of cardiovascular events later in life. Recognizing and intervening in acute BP emergencies can also decrease mortality. In hypertensive patients an electrocardiogram (ECG) can reveal several findings indicative of the heart's response to high blood pressure. Various ECG findings in hypertension include left ventricular hypertrophy changes, increased P wave amplitude, and changes in the ST-T segment. Left ventricular hypertrophy can be seen as QRS voltage which is increased in v5 v6 leads –left

ventricle leads. Also it is calculated by sokolow lyon criteria which is adding the amplitude of S wave in v1 or v2 and R wave in V5 or v6 (>35 mm-LVH) and Cornell criteria which shows S wave in avl and R wave in v3. A sum exceeding a certain threshold (e.g., 20 mm in women, 28 mm in men) suggests LVH. P wave amplitude is also seen for hypertensive patients in lead 2 and avl which indicate right atrial enlargement which also indicate pulmonary hypertension.

ST depression and T wave inversion: These changes can occur due to myocardial ischemia or injury, which can be a consequence of hypertension-related heart strain or underlying coronary artery disease.

QRS Duration (Prolonged): In some cases, hypertension can lead to a slight prolongation of the QRS duration,

reflecting a slower conduction of electrical impulses through the thickened ventricle.

QT Interval (Prolonged): The QT interval, which represents ventricular depolarization and repolarization, may also be prolonged in hypertension, potentially increasing the risk of ventricular arrhythmias.

Hence ECG is a pivotal investigation as >5 years of hypertension causes the left ventricular hypertrophy changes in ECG which is used to give an idea for cardiovascular event risk, hypertensive damage to the heart, early initiation of medications and effectiveness of antihypertensive medications.

STUDY METHODOLOGY AND AIM

This is a retrospective study done in our institution from March 2025-Feb 2026 using random selection of 100 patients after obtaining ethical clearance and informed consent from all patients who had hypertension and was on medications. In this study, the most common method

of seeing LVH in ECG by Sokolow Lyon criteria was used. The aim of the study is to correlate structural abnormalities of heart (LVH) with duration of hypertension through noninvasive test (ECG) associated with risk factors.

Risk factors

Factors taken into consideration for the study included age, sex, duration of hypertension, family history, diabetes mellitus, dyslipidemia, CAD were included.

Inclusion criteria

In this study, male and female patients with primary hypertension on treatment from age group of 30 -80 years were included.

Exclusion criteria

Patients already having other secondary of hypertension like thyroid diseases, OSA, renal artery stenosis, pregnancy, various drug use like steroids, OCP, immune suppressants were excluded.

RESULTS

In this study, it was observed that out of 100 patients studied 59 were males and 41 were females who were having positive ECG findings for LVH. Also it was found that females >60 years (25/41) {60%} and males within 60 years (34/59) {58%} was found with hypertensive criteria of LVH and ECG findings were found which was in line with national data. LVH criteria were found predominantly in men than women which is in line with national and international studies. Regarding the duration of hypertension and presence of LVH criteria in ECG, males were most affected with greater than 5 years of hypertension (-49) who were positive for sokolow Lyon criteria and females (35) had greater than 5 years duration of hypertension with positive sokolow Lyon criteria. It was also found that 10 males {17%} and 6 females {15%} had positive LVH criteria in ECG even with less than 5 years duration of hypertension which was significantly important. The risk factors like family history of hypertension, DM, dyslipidemia, CAD were contributing to hypertension findings in ECG. About 24 males>60 years and 16 females>60 years were having associated risk factors. It was also found in 22 males and 22 females who were <60 years had associated risk factors.

Table 1-ECG changes with sex

ECG changes with sex	Male	Female
ECG changes present in hypertension	59	41

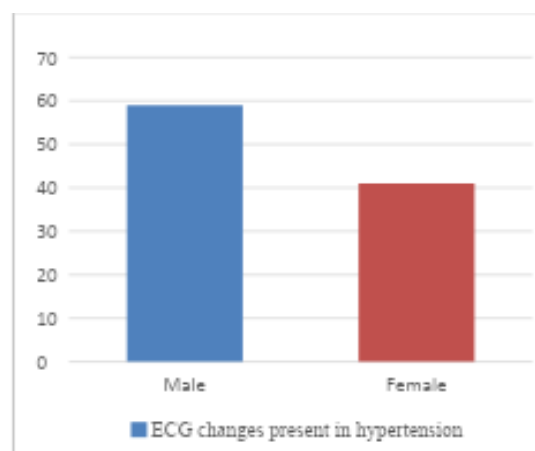
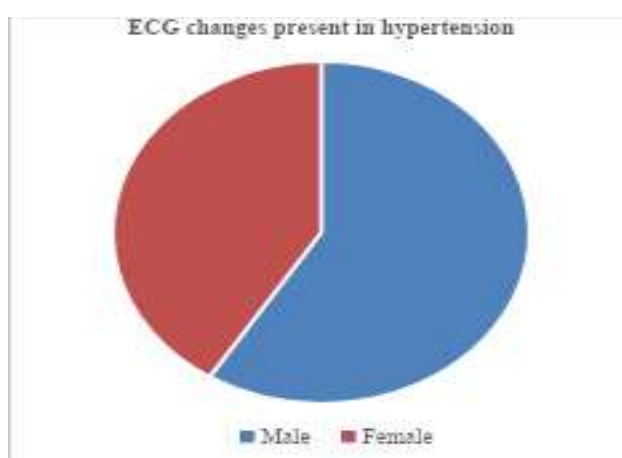


Table 2-ECG changes with age

ECG changes present	>60 years	<60 years
Male	25	34
Female	16	25

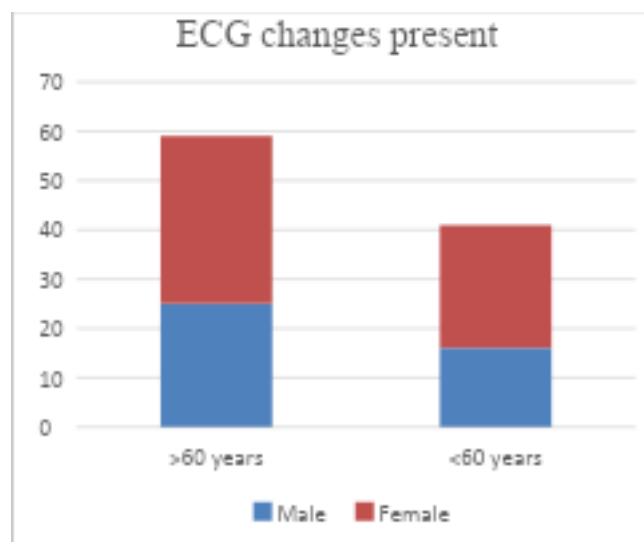
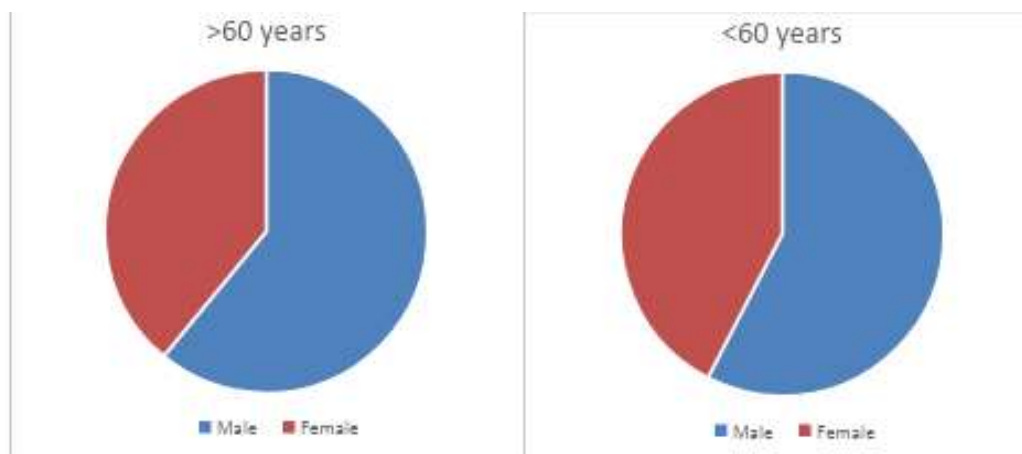
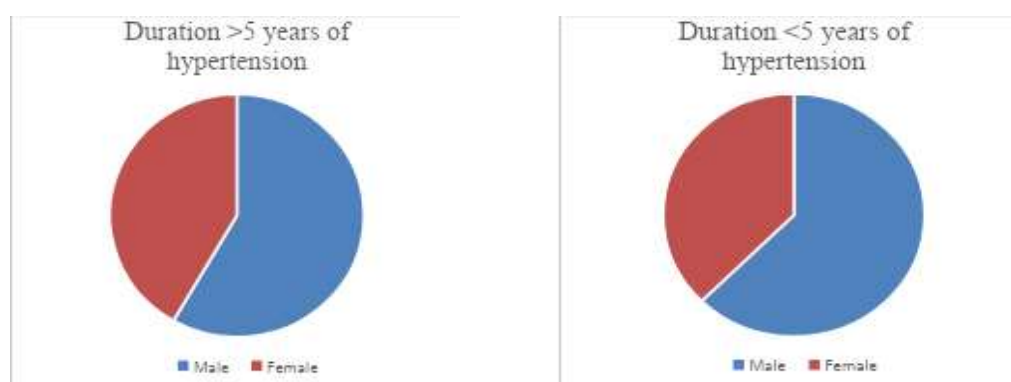
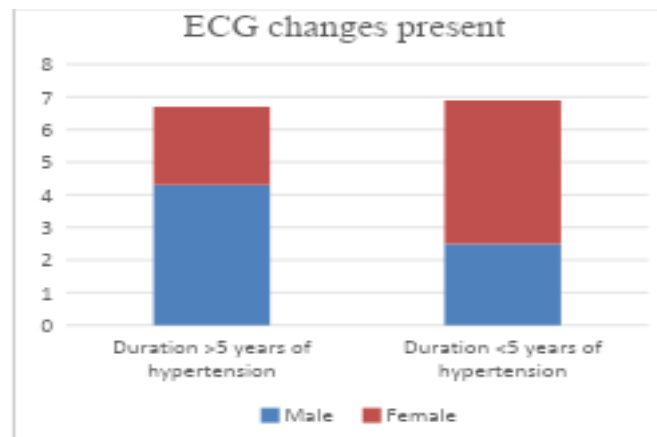


Table 3-ECG changes with duration of hypertension

ECG changes present	Duration >5 years of hypertension	Duration <5 years of hypertension
Male	49	10
Female	35	6

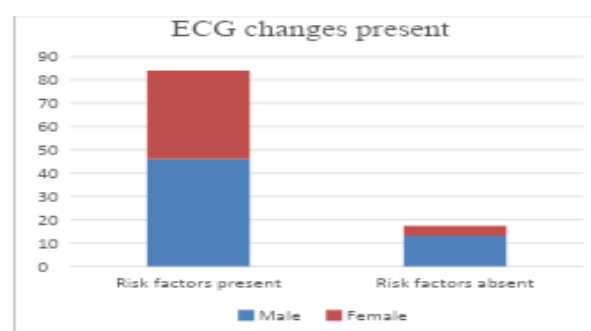
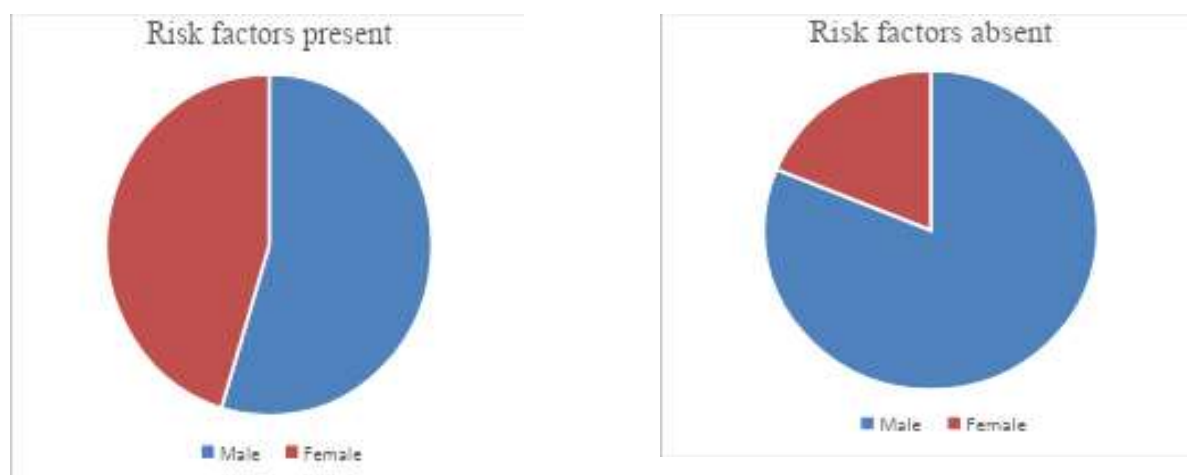




Patients having <5 years duration of hypertension (17%) of males and (15%) of females had ECG changes of LVH which is alarming and this is associated with risk factors rather than disease process by itself.

Table 4-ECG changes with risk factor association

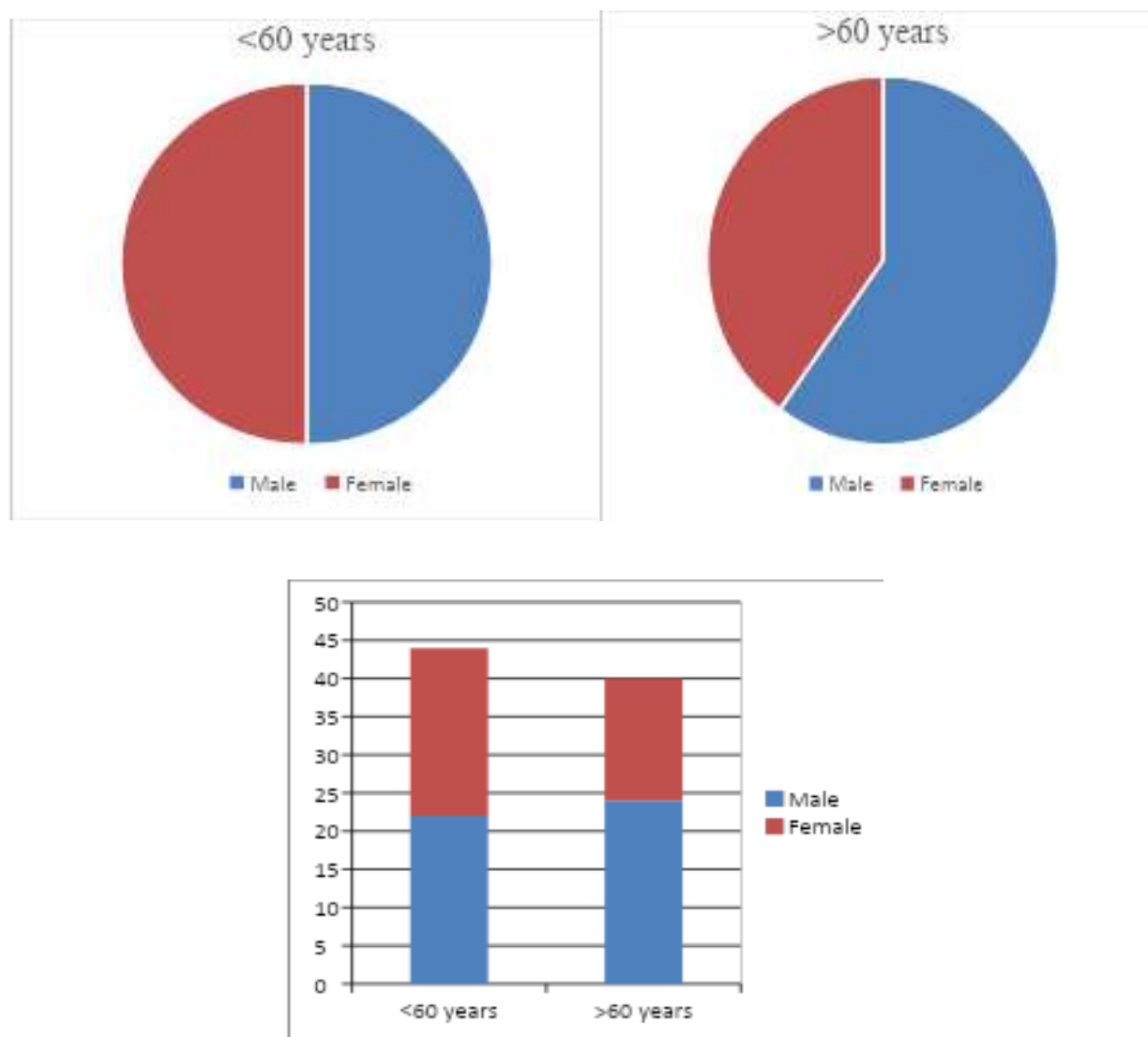
ECG changes present	Risk factors present	Risk factors absent
Male	46	13
Females	38	3



The risk factors like family history of hypertension, dyslipidemia, CAD were present in about 46 (80%) males and 38(93%) females but ECG changes were present without risk factors in 27% male patients and 7% females which was attributed to disease process itself.

Table 5-ECG changes with risk factors and age

Risk factors present	<60 years	>60 years
Male	22	24
Female	22	16



Comparison with national study data

The present study in comparison with national data, males and females with hypertension had ECG findings out of which males had more left ventricular hypertrophy than females and males less than 60 years of age, (younger males) were having positive LVH criteria in ECG which matches with national data. In our study, it was also found that ECG findings appeared in 49 males and 35 females with >5 years duration of hypertension which contributed to the risk factors like family history, DM, dyslipidemia and CAD. It was also found that 10/59 (17%) males and 6/41 (15%) females were having positive LVH criteria within 5 years duration of hypertension which was alarming when compared to national studies. The risk factors like family history of hypertension, dyslipidemia, CAD contributed which is in line with national data. The presence of risk factors was mostly associated with 24 males and 16 females >60 years and 22 males and 22 females <60 years of age matching with national data which is also alarming, as the risk factors were equally distributed in less than 60 years in both sexes which contributed to the ECG changes in hypertension.

Comparison with international study data

In our study, it was found both males and females with hypertension had ECG findings out of which males had more left ventricular hypertrophy than females and males less than 60 years of age, (younger males) were having positive LVH criteria in ECG which matches with international data. It was also found that ECG findings appeared in 49 percent males and 35 percent females with >5 years duration of hypertension which contributed to the risk factors like family history, DM, dyslipidemia and CAD, thereby patients with 5-15 years median duration of hypertension was positive for ECG findings as in international studies.

Limitations

Many people having other causes of secondary hypertension like pregnancy, OSA, pheochromocytoma, RAS,

various endocrine disorders, medicine induced (steroids), used for autoimmune conditions, old debilitated and pregnant patients, fragile patients, arthritis patients, valvular heart disease patients, COPD patients were not taken into consideration. More follow up study is required as small number of population was considered in this analysis. The sensitivity of ECHO study is significant for hypertension but still ECG can be used as screening tool for prediction of mortality from CAD.

CONCLUSION

Our study has made ECG (noninvasive) test, a mandatory test for patients with hypertension as a tool for structural assessment of the heart so that early diagnosis and management of hypertension and prevention of mortality due to CAD can be made

Implications on society- Our study of ECG findings in hypertension in concordance with national and international study data has proved that ECG is a reliable and sensitive tool which is noninvasive to detect hypertension and its complications like CAD at the earliest for better management.

REFERENCES

1. Prisant LM, Carr AA. Beyond diagnosis of left ventricular hypertrophy in patients with essential hypertension. *Am J Hypertens.* 1992.
2. Levy D. Left ventricular hypertrophy. Epidemiological insights from the Framingham Heart Study. *Drugs.* 1988;
3. Kannel WB. Left ventricular hypertrophy as a risk factor: the Framingham experience. *J Hypertens Suppl.* 1991;
4. Prisant LM, Houghton JL, Bottini PB, et al. Hypertensive heart disease. How does blood pressure affect left ventricular mass? *Postgrad Med.* 1994
5. Arnett DK, Strogatz DS, Ephross SA, et al. Greater incidence in black men than in white men in Evans County, Georgia. *Ethn Dis.* 1992
6. Williams B., Mancia G., Spiering W., Agabiti Rosei E., Azizi M., Burnier M., Clement D. L., Coca A., de Simone G., Dominiczak A., Kahan T., Mahfoud F., Redon J., Ruilope.
7. L., Zanchetti A., Kerins M., Kjeldsen S. E., Kreutz R., Laurent S., Lip G. Y. H., McManus R., Narkiewicz K., Ruschitzka F., Schmieder R. E., Shlyakhto E., Tsioufis C., Aboyans V
8. Lehtonen A. O., Puukka P., Varis J., Porthan K., Tikkanen J. T., Nieminen M. S., Huikuri
9. H. V., Anttila I., Nikus K., Kähönen M., Jula A., and Niiranen T. J., Prevalence and prognosis of ECG abnormalities in normotensive and hypertensive individuals, *Journal of Hypertension.* (2016).
10. Bird K., Chan G., Lu H., Greeff H., Allen J., Abbott D., Menon C., Lovell N. H., Howard N., Chan W. S., Fletcher R. R., Alian A., Ward R., and Elgendi M., Assessment of hypertension using clinical electrocardiogram features: a first-ever review, *Frontiers of Medicine.* (2020)
11. Miceli F., Presta V., Citoni B., Canichella F., Figliuzzi I., Ferrucci A., Volpe M., and Tocci G., Conventional and new electrocardiographic criteria for hypertension-mediated cardiac organ damage: a narrative review, *Journal of Clinical Hypertension.* (2019)
12. Palmieri V., Okin P. M., Bella J. N., Wachtell K., Oikarinen L., Gerds E., Boman
13. K., Nieminen M. S., Dahlöf B., and Devereux R. B., Electrocardiographic strain pattern and left ventricular diastolic function in hypertensive patients with left ventricular hypertrophy: the LIFE study, *Journal of Hypertension.* (2006)
14. Pewsner D., Jüni P., Egger M., Battaglia M., Sundström J., and Bachmann L. M., Accuracy of electrocardiography in diagnosis of left ventricular hypertrophy in arterial hypertension: systematic review, *BMJ.* (2007)
15. Van Kleef M. E. A. M., Visseren F. L. J., Vernooij J. W. P., Nathoe H. M., Cramer M. J. M., Bemelmans R. H. H., Van der Graaf Y., and Spiering W., Four ECG left ventricular hypertrophy criteria and the risk of cardiovascular events and mortality in patients with vascular disease, *Journal of Hypertension.* (2018)
16. Ben-Shlomo Y., Spears M., Boustred C., May M., Anderson S. G., Benjamin E.
17. J., Boutouyrie P., Cameron J., Chen C. H., Cruickshank J. K., Hwang S. J., Lakatta E. G., Laurent S., Maldonado J., Mitchell G. F., Najjar S. S., Newman A. B., Ohishi
18. M., Pannier B., Pereira T., Vasan R. S., Shokawa T., Sutton-Tyrell K., Verbeke F., Wang K. L., Webb D. J., Willum Hansen T., Zoungas S., McEnery C. M., Cockcroft J. R.,
19. and Wilkinson I. B., Aortic pulse wave velocity improves cardiovascular event prediction: an individual participant meta-analysis of prospective observational data from 17, 635 subjects, *Journal of the American College of Cardiology.* (2014).