Advances in Health Sciences Research, volume 37

Proceedings of the 12th Annual Scientific Meeting, Medical Faculty, Universitas Jenderal Achmad Yani, International Symposium on "Emergency Preparedness and Disaster Response during COVID 19 Pandemic" (ASMC 2021)

Correlation of Left Ventricular Mass Index on Echocardiography with Thorax Photo in Hypertensive Patients

Prihati Pujowaskito*
Department of Cardiology and Vascular Medicine
RSPAD Gatot Soebroto
Jakarta, Indonesia
*prihati.pujo@fk.unjani.ac.id

Dinda Dwi Lazuardi Emha
Faculty of Medicine
Jenderal Achmad Yani University
Cimahi, Indonesia

Ilma Fiddiyanti
Department of Radiology
RS TK II Dustira
Cimahi, Indonesia

Fahmi Nur Hidayatullah
Faculty of Medicine
Jenderal Achmad Yani University
Cimahi, Indonesia

***Abstract*—Hypertension is a condition that occurs in someone who has systolic blood pressure ≥140 mmHg and or diastolic blood pressure ≥90 mmHg on repeated examination. If hypertension is left and untreated, it will be lead to damage the organs such as left ventricular hypertrophy (LVH). Changes that occur in the heart of hypertensive patients, which include structural changes in the form of hypertrophy and dilatation in the left ventricle, can be assessed not only by the thorax photo but LVH can also be objectively demonstrated by the left ventricular mass index (LVMI) through echocardiography examination. This research is an analytical study by taking patient's medical record data, then it will be presented in tabular format. The results of collecting data is found that there are 38 patients who appropriate with the inclusion and exclusion criteria. The highest number, 23 person, is hypertensive patients that show LVH by echocardiography examination and also cardiomegaly by thorax photo (85.19%), then the lowest number, 1 person, is hypertensive patient that does not have LVH by echocardiography examination and has a normal condition by thorax photo (9,09%). There are also 10 person of hypertensive patients that show cardiomegaly by thorax photo but do not have LVH by echocardiography examination (90,91%) and 4 person others of hypertensive patients that show have LVH by echocardiography examination but do not have cardiomegaly by thorax photo (14,81%). The conclusion is that there is no correlation between the left ventricular mass index on echocardiography examination and thorax photo in hypertensive patients.**

Keywords—echocardiography, hypertension, LVH, thorax photo

I. INTRODUCTION

The prevalence of hypertension in Indonesia based on basic health research in Indonesia obtained through measurements at ≥18 years of age is 25.8% with the highest prevalence in Bangka Belitung which is 30.9% and West Java ranks fourth, namely 29.4% [1]. The Year 2016 In West Java, 790,382 cases of hypertension were found, spread over 26 districts/cities. One of them is Cimahi City with a percentage of 2.96% [2]. There are modifiable factors and non-modifiable factors that can put a person at risk of developing hypertension. Modifiable risk factors include smoking, salt consumption, saturated fat consumption, use of used cooking, alcohol consumption habits, obesity, lack of physical activity, stress, and use of the hormone estrogen. Meanwhile, the factors that cannot be modified are age, gender, family history, and genetics [3]. Based on the report of Sartik et al. [4] in Palembang, hypertension sufferers who were more than 40 years old were 31.5% and for the prevalence based on gender, the distribution of men was 25.7% while women were 20.6%. The incidence of hypertension increases with age. Individuals who have a family history of hypertension have a 2 times greater risk of suffering from hypertension than people who do not have a family history of hypertension. Based on the smoking habit, hypertension occurred 31%, while it was also found that 33.3% of hypertensive patients had smoked for ≥5 years. Based on the data above, hypertension is a disease that involves many factors. If left untreated, this situation will cause various complications in the form of damage to target organs [4]. The highest prevalence of target organ damage in hypertensive patients is left ventricular hypertrophy (LVH). LVH is the cardiac compensation against an increased afterload. High blood pressure can increase the workload of the heart which

over time can cause thickening of the heart muscle. Thickening of the heart muscle prolonged will result in left ventricular hypertrophy as compensation for the heart to increase contractions [5].

LVH can be assessed in several ways. Among them by measuring the cardiothoracic ratio (CTR) on the posteroanterior (PA) and anteroposterior (AP) chest X-ray. If the measurement results are more than 50 percent, the heart is said to be enlarged in the atria or ventricles [6].

Also, other supporting examinations can be performed on hypertensive patients to assess the left ventricular mass, namely echocardiography which can find LVH earlier because has high sensitivity and specificity. One of the echocardiographic parameters used to diagnose LVH is LVMI. The threshold value for LVH based on the guidelines issued by the American Society of Echocardiography (ASE) and the European Association of Echocardiography (EAE) is LVMI > 115 g/ mm^2 for men and LVMI > 95g mm^2 for women [7].

Hypertension can cause many complications, one of which is the thickening of the heart wall or LVH due to the compensatory mechanism of the heart which continues to pump blood out in hypertensive conditions. This thickening condition in the heart wall can cause enlargement of the heart, which we can assess in various ways, including by performing an echocardiography examination to assess the levt ventricular mass index (LVMI) or by performing a chest X-ray to assess the cardiac thoracic ratio (CTR). Based on this the researchers were interested in conducting this study about correlation of left ventricular mass index on echocardiography with thorax photo in hypertensive patients.

II. METHODS

The research design that has been carried out is an observational analytic study with a cross-sectional data design. The type and method of this study were chosen to determine the correlation between the increase in a left ventricular mass index and chest X-ray images in hypertensive patients. The subjects in this study were the medical records of hypertensive patients at Dustira Hospital for the period January to December 2019.

The variables studied were several patients classified as hypertension according to JNC VII seen from medical records, had echocardiography done and there was an LVMI value, a PA or AP chest photo was performed and patient medical records accompanying gender and age data. Data processing was carried out using Microsoft Excel 2016 and presented in table form which is discussed descriptively and analytically.

This study was conducted on 38 hypertensive patients at Dustira Cimahi Hospital for the period January-December 2019 who met the study inclusion criteria. This study aims to describe the correlation of the left ventricular mass index on echocardiography with chest X-ray images of hypertensive patients at Dustira Cimahi Hospital for the period January-December 2019.

III. RESULTS AND DISCUSSION

The general characteristics of research subjects consisted of gender, age and degree of hypertension. Furthermore, the research subjects will conduct an assessment of the left ventricular mass index (LVMI) and also the chest X-ray, which can be seen in table 1.

TABLE I. FREQUENCY DISTRIBUTION OF GENERAL CHARACTERISTICS OF RESEARCH SUBJECTS

Variables	Frequency (n)	Percentage (%)
Gender		
Male	17	44.74
Female	21	55.26
Total	38	100.00
Age		
35-44 year	7	18.42
45-54 year	6	15.79
55-64 year	14	36.84
65-74 year	7	18.42
≥ 75 year	4	10.53
Total	38	100.00
Grade of Hypertension		
Hypertenison Grade I	20	52.63
Hypertension Grade II	18	47.37
Total	38	100.00
LVMI		
Not LVH	11	28.95
LVH	27	71.05
Total	38	100.00
CTR		
Normal	5	13.16
Kardiomegali	33	86.84
Total	38	100.00

The data in Table 1 shows that most of the research subjects were female, namely as many as 21 people (55.26%), and the rest were male as many as 17 people (44.74%).

In this study, it was found that the prevalence of hypertension patients was more in women. In some previous studies this could be because in women the hormonal influence is higher than in men. But studies which indicated no relationship attributes the high prevalence of HT in postmenopausal women to increased body mass index (BMI). An extensive population-based study by Casiglia et al. underlined that postmenopausal women seemed to have higher BP values and worse risk profile than premenopausal women but this was attributable to their older age [8]. On the other hand, some studies reported that both systolic and diastolic BP were found to be higher in menopause independent of age, BMI, pulse rate, and hormone replacement treatment (HRT). After five years of the follow-up of 315 women and age and BMI-matched men showed postmenopausal women had higher baseline BP and only peri- and postmenopausal women had an increase in systolic BP of approximately 5 mmHg [8,9].

Another data in Table 1 shows that most of the research subjects were aged between 55-64 years, as many as 14 people (36.84%), 7 people aged 35-44 years (18.42%), ages 45-54

years as many as 6 people. (15.79%), 7 people aged 65-74 years (18.42%) and 4 people aged ≥ 75 years (10.53%).

In this study, it was found that the prevalence of hypertension patients was more in people aged 55-64 years. Elevated blood pressure is positively correlated with cognitive impairment in the middle aged, but this positive association declines with increasing age. These results indicated that specific blood pressure management strategies for various age groups may be crucial for maintaining cognitive vitality. But apart from that, it is necessary to look at other variables which are not assessed which may have an effect on the incidence of hypertension besides age, namely unhealthy living habits, such as eating foods high in salt, consuming insufficient fruit, alcohol use, inadequate and inadequate activity exercise, and stress [10-12].

The data in Table 1 also shows that most of the research subjects had level I hypertension, as many as 20 people (52.63%) and 18 people (47.37%) had level II hypertension. Obtained the mean value of systolic blood pressure amounted to 158.16 mmHg and a standard deviation value of 16.08. Meanwhile, diastolic blood pressure obtained a mean value of 94.74 mmHg and a standard deviation value of 10.59.

Another data in Table 1 shows that most of the study subjects experienced LVH incidence, namely 27 people (71.05%) and 11 people (28.95%) others did not experience LVH.

Left ventricular hypertrophy (LVH) is defined by the increased left ventricular mass; with myocardial cell hypertrophy and an increase in collagen within myocardium. Multifactor etiology for LVH has been implicated including, age, sex, body size, blood pressure and diabetes. Most hypertensive patients experienced left ventricular hypertrophy. Pathological changes in hypertension induced by chronic pressure overload include an increase in the size of the cardiac myocytes, changing composition of the extracellular matrix with increase of collagen fibers and abnormal changes in intra myocardial coronary vessels. However, most attention has been put on risk factors associated with LVH, and on the beneficial effects of pharmacological treatment, as there is detrimental contribution of LVH to cardiovascular events and survival. A small proportion of hypertensive patients in this study did not experience LVH, this could occur due to risk factors such as the length of time the person had hypertension, antihypertensive therapy, and physical activity [13-15].

The last data in Table 1 shows that most of the chest X-ray of the research subjects were cardiomegaly, namely as many as 33 people (86.84%), and the remaining 5 people (13.16%) were normal.

It is apparent that hypertensive patients have higher CTR due to the effect of hypertension in increasing LVMI, which results in LVH with its attendant increase in oxygen consumption, reduced coronary blood flow, and subsequent sequela. A small proportion of hypertensive patients may not experience cardiomegaly, this can be due to many factors, the position of the patient's chest X-ray, the patient's body shape varies, the patient has received therapy, and the results of the chest X-ray are not the latest results that describe the patient's current condition [16].

TABLE II. ANALYSIS OF THE CORRELATION BETWEEN LEFT VENTRICULAR MASS INDEX AND THORACIC PHOTO IMAGES IN HYPERTENSIVE PATIENTS

CTR				
Variabel	**Normal**	**Kardiomegali**	**Total**	***P***
	n (%)	***n (%)***	***n (%)***	
Not LVH	1 (9,09%)	10 (90,91%)	11 (100%)	0,647
LVH	4 (14,81%)	23 (85,19%)	27 (100%)	
Total	5 (13,11%)	33 (86,84%)	38 (100%)	

Based on table 2 above, it is known that the highest number of hypertensive patients who have left ventricular hypertrophy (LVH) with cardiomegaly chest X-ray results are 23 people (85.19%) and the lowest number is patients who do not experience left ventricular hypertrophy with normal chest X-ray results. as many as 1 people (9.09%).

Based on the results of statistical analysis using the Spearman correlation test, the p-value of significance was 0.647> 0.05. So it can be concluded that there is no correlation between the left ventricular mass index on echocardiography and chest photo images in hypertensive patients at Dustira Hospital for the period January-December 2018.

The theory also states that left ventricular hypertrophy is caused by increased stress on the ventricular wall and chronic excessive pressure (e.g. hypertension) in the left ventricle. In the early phase of mild hypertension, there is a grade I diastolic dysfunction, if the ventricle is not treated, the filling pressure will increase so that ventricular hypertrophy occurs in response to chronic excessive pressure in the left ventricle [17,18].

In this study, only research was conducted regarding the correlation of the ventricular mass index with radiological images in hypertensive patients, research on the duration of hypertension was not carried out due to limitations in the study, namely the absence of data on the duration of hypertension. Also, this study has the limitation that it is a short study time that does not allow a cohort study to be identified first as a cause or risk factor, and then subjects are followed prospectively over a while to look for effects [19].

Changes that occur in the heart of hypertensive patients, which include structural changes in the form of hypertrophy and dilation of the left ventricle, can be assessed through chest X-ray, it is said to be cardiomegaly if the CTR is ≥ 50%. Also, left ventricular hypertrophy can be shown objectively by an increase in the left ventricular mass index (LVMI) that is greater than the normal number according to sex through echocardiography [6,7].

In theory, chest X-rays are very limited in determining LVH. In the anteroposterior position, it is possible to observe the apex cordis and left ventricular bulge when LVH occurs. However, hypertrophy does not change the silhouette of the

heart on the chest X-ray. When the left ventricle shows more pronounced disturbance, resulting in dilation, the chest X-ray may show an increased cardiothoracic ratio (CTR). So the possibility of 10 people (90.91%) hypertensive patients with cardiomegaly but not LVH experienced left ventricular dilatation [20].

IV. CONCLUSION

Based on the results of research conducted by researchers, it can be concluded that:

- The general characteristics of hypertensive patients with chest X-ray and echocardiography examination at Dustira Cimahi Hospital were that most of the study subjects were female, namely, 21 people (55.26%), most of the study subjects were aged between 55- 64 years, as many as 14 people (36, 84%), and most of the research subjects had a degree of hypertension level I as many as 20 people (52.63%).
- The description of the left ventricular mass index in hypertensive patients at Dustira Cimahi Hospital is that most of the study subjects experienced LVH incidence, namely 27 people (71.05%) and 11 people (28.95%) others did not experience LVH.
- Chest X-ray image in hypertensive patients at Dustira Cimahi Hospital is that most of the thoracic photos of the study subjects were cardiomegaly, namely 33 people (86.84%) and the remaining 5 people (13.16%) were normal.
- The highest number were hypertensive patients who experienced left ventricular hypertrophy (LVH) with cardiomegaly chest X-ray results, namely, 23 people (85.19%) and the lowest number were patients who did not experience left ventricular hypertrophy with normal chest X-ray results, namely 1 person (9,09%). There were also 10 patients with hypertension who had cardiomegaly but not LVH (90.91%) and LVH but not cardiomegaly as many as 4 people (14.81%). There was no correlation between the left ventricular mass index on echocardiography and chest photo images in hypertensive patients at Dustira Hospital for the period January to December 2019 (p = 0.647).

REFERENCES

[1] Departemen Kesehatan Republik Indonesia, Laporan hasil riset kesehatan dasar (Riskesdas). Jakarta: Departemen Kesehatan Republik Indonesia, 2013.

[2] Dinas Kesehatan Provinsi Jawa Barat, Profil kesehatan. Bandung: Dinas Kesehatan Provinsi Jawa Barat, 2016.

[3] Pusat Data dan Informasi Kementrian Kesehatan Republik Indonesia, Hipertensi, Jakarta: Pusat Data dan Informasi Kementrian Kesehatan Republik Indonesia, 2014.

[4] R.S. Tjekyan, and M. Zulkarnain, "Faktor–faktor risiko dan angka kejadian hipertensi pada penduduk Palembang," Jurnal Ilmu Kesehatan Masyarakat, vol. 8, pp. 180-191, 2017.

[5] G. Shlomai, G. Grassi, E. Grossman, and G. Mancia, "Assessment of target organ damage in the evaluation and follow-up of hypertensive patients: where do we stand?," The Journal of Clinical Hypertension, vol. 15, pp. 742-747, 2013.

[6] K. Dimopoulos, G. Giannakoulas, I. Bendayan, E. Liodakis, R. Petraco, G.P. Diller, and M.A. Gatzoulis, "Cardiothoracic ratio from postero-anterior chest radiographs: a simple, reproducible and independent marker of disease severity and outcome in adults with congenital heart disease," International journal of cardiology, vol. 166, pp. 453, 2013.

[7] A. Barbieri, F. Bursi, F. Mantovani, C. Valenti, M. Quaglia, E. Berti, and M.G. Modena, "Left ventricular hypertrophy reclassification and death: application of the Recommendation of the American Society of Echocardiography/European Association of Echocardiography," European Heart Journal–Cardiovascular Imaging, vol. 13, pp. 109, 2012.

[8] E. Casíglia, D. d'Este, G. Ginocchio, G. Colangeli, C. Onesto, P. Tramontin, and A.C. Pessina, "Lack of influence of menopause on blood pressure and cardiovascular risk profile: a 16-year longitudinal study concerning a cohort of 568 women," Journal of hypertension, vol. 14, pp. 729-736, 1996.

[9] S.L. Daugherty, F.A. Masoudi, J.L. Ellis, P.M. Ho, J.A. Schmittdiel, H.M. Tavel, and D.J. Magid, "Age dependent gender differences in hypertension management," Journal of hypertension, vol. 29, pp. 1005, 2011.

[10] S. Shang, P. Li, M. Deng, Y. Jiang, C. Chen, and Q. Qu, "The age-dependent relationship between blood pressure and cognitive impairment: a cross-sectional study in a rural area of Xi'an, China," PLoS One, vol. 11, pp. e0159485, 2016.

[11] S.U. Chasanah, and N. Syarifah, "Hubungan karakteristik individu penderita hipertensi dengan derajat hipertensi di puskesmas Depok II Sleman Yogyakarta," Jurnal Formil (Forum Ilmiah) KesMas Respati, vol. 2, pp. 1- 9, 2017.

[12] World Health Organization (WHO), A Global Brief On Hypertention. Switzerland: WHO, 2013.

[13] T. Waseem, M.A. Nadeem, T. Ali, and A.H. Khan, "Left ventricular hypertrophy (LVH): Sensitivity of different electrocardiographic criteria to diagnose LVH in patients having increased left ventricular mass index on echocardiography," Ann King Edward Med Coll, vol. 9, 2003.

[14] B.M. Mayosi, B. Keavney, A. Kardos, C.H. Davies, P.J. Ratcliffe, M. Farrall, and H. Watkins, "Electrocardiographic measures of left ventricular hypertrophy show greater heritability than echocardiographic left ventricular mass," European heart journal, vol. 23, pp. 1963, 2002.

[15] P. Verdecchia and F. Angeli, "Reversal of left ventricular hypertrophy: What have recent trials taught us?" Am J Cardiovasc Drugs, vol. 4, pp. 369–78, 2004.

[16] N.A. Lestari, Hubungan derajat hipertensi dengan cardiothoracic ratio pada pasien rawat inap di Rumah Sakit Dustira periode januari-september 2013. Cimahi: Fakultas Kedokteran Universitas Jenderal Achmad Yani, 2014.

[17] A.Z. Meitadevi and B.Y. Setianto, Pengaruh lamanya hipertensi terhadap kejadian hipertrofi ventrikel kiri pada elektrokardiografi. Yogyakarta: Universitas Muhammadiyah Yogyakarta, 2012.

[18] S.S. Purwohudoyo, Pemeriksaan kalainan-kelainan kardiovaskular dengan radiografi polos. Jakarta: penerbit Universitas Indonesia, 1984.

[19] S. Sastroasmoro and S. Ismael, Dasar-dasar metodologi penelitian klinis. Edisi III. Jakarta: Sagung Seto, 2010.

[20] T.E. Keats, Measurements of the heart and aorta in adults. In: Lusted LB, Keats TE. Atlas of roentgenographic measurements. 3rd ed. Chicago: Year Book Medical, 1983, p.190-195.