Relationship between Carotid Intima-Media Thickness and Left Ventricular Hypertrophy

Yusrina Saragih *, Harris Hasan, Zainal Safri, Zulfikri Mukhtar, Refli Hasan, Nizam Akbar

Department of Cardiology and Vascular Medicine, Faculty of Medicine, Universitas Sumatera Utara – Haji Adam Malik Hospital, Medan, North Sumatera, Indonesia

Corresponding author:
Yusrina Saragih, MD, - email: yusrinasaragih@gmail.com
Address: Department of Cardiology and Vascular Medicine, Faculty of Medicine, Universitas Sumatera Utara – Haji Adam Malik Hospital, Jalan Bunga Lau, Medan, Indonesia

Manuscript submitted: October 8, 2018; Revised and accepted: April 22, 2019

ABSTRACT

Background: Hypertension is a 50% cause of cardiovascular disease and stroke, 40% of cause of death in Diabetics, and is a major risk of kidney failure, pregnancy and dementia. Left ventricular hypertrophy (LVH) is a preclinical manifestation of cardiovascular disease and a strong predictor of cardiovascular morbidity and mortality. Examination of carotid intima-media thickness (CIMT) is one method that can be used to Evaluate the occurrence of coronary heart disease and in Several studies reported that CIMT is also associated with left ventricular function and hypertrophy

Methods: This cross-sectional study conducted on hypertensive patients in the outpatient unit in Cardiac Center Haji Adam Malik General Hospital since March 2018-August 2018. Examination of Carotid B-Mode ultrasound was conducted to obtain CIMT values. LVH is assessed by left ventricle mass index (LVMI) as measured by M-mode method using the Cube formulas from echocardiography. Then the analysis is done using the Spearman correlation test to see the relationship between CIMT and LVH

Results: The CIMT >0.5 mm have a positive correlation with LVM ($r = 0.594$, $p < 0.001$), LVMI ($r = 0.618$, $p < 0.001$), RWT ($r = 0.364$, $p < 0.001$), and LVH ($r = 0484$, $p < 0.001$). The CIMT >0.5 mm has a sensitivity of 83.6%, specificity 90.4%, PPV NPV 76% and 93.8%. The CIMT value of 0:55 mm is considered to be the optimal value in diagnosing LVH in hypertensive patients in our subjects based on the ROC curve with a sensitivity of 83.6% and specificity of 90.5%, and area under the curve of 0.9.

Conclusion: There is a positive correlation between carotid intima-media thickness and left ventricular hypertrophy in hypertensive patients

Keywords: carotid intima-media thickness; left ventricle hypertrophy; left ventricle mass; hypertension

INTISARI

Latar Belakang: Hipertensi merupakan 50% penyebab kejadian penyakit kardiovaskuler dan stroke, 40% penyebab kematian pada penderita diabetes, dan merupakan risiko utama terjadinya gagal ginjal, keracunan kehamilan dan demensia. Hipertrofi ventrikel kiri (HVK) merupakan manifestasi preklinis dari penyakit kardiovaskular dan merupakan prediktor kuat untuk morbiditas dan mortalitas kardiovaskular. Pemeriksaan ketebalan intima-media karotis (KIMK) merupakan salah satu metode yang dapat digunakan untuk mengevaluasi terjadinya penyakit jantung koroner dan dalam beberapa penelitian dilaporkan bahwa ketebalan intima-media karotis juga berhubungan dengan fungsi dan hipertrofi ventrikel kiri.

Metode: Penelitian ini merupakan studi potong lintang yang dilakukan pada pasien hipertensi di unit rawat jalan Pusat Jantung Terpadu RSUP Haji Adam Malik Medan sejak Maret 2018-Agustus 2018. Pemeriksaan *B-Mode* USG Karotis dilakukan untuk memperoleh nilai KIMK. HVK dinilai dengan indeks massa ventrikel kiri (IMVK) yang diukur melalui metode *M-mode* dengan menggunakan formula *Cube* dari ekokardiografi. Kemudian dilakukan analisa dengan menggunakan uji korelasi *Spearman* untuk melihat hubungan KIMK dengan HVK

Hasil: Nilai KIMK > 0.5 mm memiliki korelasi positif dengan MVK (r=0,594, p<0,001), IMVK (r=0,618,p<0,001), *RWT* (r=0,364,p<0,001), dan HVK (r=0,484,p<0,001). KIMK >0.5 mm memiliki sensitivitas 83.6%, spesifisitas 90.4%, *NPV* 76% dan *PPV* 93.8%. Nilai KIMK 0.55 mm dianggap merupakan nilai optimal dalam mendiagnosis HVK pada pasien hipertensi di rumah sakit kami berdasarkan kurva ROC dengan sensitivitas 83.6% dan spesifisitas 90.5%, dan area bawah kurva 0.9.

Kesimpulan: Terdapat korelasi positif antara ketebalan intima-media karotis dengan hipertrofi ventrikel kiri pada pasien hipertensi.

INTRODUCTION

Hypertension is the greatest public health burden in worldwide. According to the International Society of Hypertension (ISH), in 2014, the rise in blood pressure > 140/80 mmHg, causing 9.4 million deaths in 2010 worldwide.[1] Many studies reported that hypertension is 50% cause incidence of cardiovascular diseases and stroke, 40% of the cause of death in diabetics, and major risk of kidney failure, eclampsia and dementia.

Hypertension is associated with reduced life expectancy, and damage to the target organ or target-organ damage (TOD) such as the heart, kidneys, blood vessels and others. TOD early detection is a preventive measure to reduce the morbidity and mortality due to hypertension. Structural adaptation of heart and blood vessels in hypertensive patients is interesting to study the last few years relating to the clinical course and prognosis of the disease.[2]The degree of cardiovascular involvement in hypertension is very useful in the prognosis index. Therefore, left ventricular hypertrophy (LVH) is an important sign and become an independent risk factor for the occurrence of cardiovascular complications.[2]

Left ventricular mass is a marker of LVH as well as a strong and independent factor in predicting cardiovascular mortality and morbidity even in the normal range.[3] However, measurement of left ventricular mass by echocardiography is relatively complex and requires a lot of time and the value of feasibility never reach 100%, so that other cardiovascular parameters that have the same ability to predict cardiovascular risk are needed as well as left ventricular mass but are more easily applied clinically with few limitations.

Examination of carotid intima-media thickness (CIMT) is one method that can be used to evaluate the occurrence of coronary heart disease.[4] And in several studies reported that carotid intima-media thickness was also associated with the function and

left ventricular hypertrophy.[4]Therefore several studies have shown a strong association between carotid intima-media thickness and left ventricular mass in hypertensive patients and in elderly patients[3], the researchers wanted to know the relationship value carotid intima-media thicknesswith the presence or absence of left ventricular hypertrophy.

METHODS

Study Design and Population

A cross-sectional study was conducted at the Haji Adam Malik General Hospital with approval from the Ethics Committee of Research Faculty of Medicine, University of Sumatera Utara- Haji Adam Malik General Hospital for ethical clearance. From March to August 2018, all outpatient unit in Cardiac Centre Haji Adam Malik General Hospital who diagnosed with hypertension according to JNC VII[5], aged 18-60 years with or without diabetes mellitus or dyslipidemia who are willing to do echocardiography and carotid ultrasound examination, without ischemic heart disease without heart failure, with no history of stroke or TIA, without claudication, without carotid artery stenosis, without valvular heart disease without congenital heart disease. Exclusion criteria include patients who refuse examination and poor echo window.

We documented history of previous disease, history of medication used, weight, height, the initial physical examination, ECG, laboratory tests and risk factors for cardiovascular disease. Examination of CIMT is the thickness of the components of the tunica intima and tunica media on the walls of the carotid artery (CCA, bifurcation and ICA) right and left, shown as a pattern of double line as measured by ultrasound B-mode[6]and taken the highest value of the entire examination (CCA, ICA, bifurcation) using MedisonAccuvix 10 Linear Probe 7-frequency of 15 Hz.

Echocardiographic examination performed by the lateral decubitus position using GE Vivid S6 with heart sector probe frequency of 3.2 MHz. Electrocardiography using CardioTouch 3000 Bionet tool speed 25mm / s, the scale of 10mV / mm. At each echocardiography collected data from the diameter of the left atrium, left ventricular end-diastolic dimension (LVEDD), the thickness of the left ventricular wall, transmitral peak early (E) and peak late (A) diastolic filling velocities, and left ventricular ejection fraction by the method of biplanes Simpson, the value of e'lateral and septal. All measurements were performed in 3 times of the cardiac cycle and calculated the average of each parameter.

Left ventricular mass (LVM) was calculated based on a formula of The Devereux-modified ASE:

LVM = 1.04 The x0.8 x {(IVSD + LVEDD + PWD) 3 - LVEDD3} x 10-3 + 0:06 (g)

Left ventricular mass index is: LVMI = LVM / BSA

Then all data were collected and analyzed. Processing and statistical data analysis using statistical computer software. Categorical variables were presented with the number or frequency (n) and percentage (%). Numerical variables were presented with the average value (mean) with a standard deviation for normally distributed data. Normality test numeric variable across all study subjects using the Kolmogorov-Smirnov test with n> 50. The comparison between the two groups on categorical independent variables and categorical dependent variable was done using Pearson Chi Square. Numerical LV mass, LVMI and Relative wall thickness will be tested relationship with the thickness of the intima with linear regression. Pearson correlation test was performed for normally distributed data and Spearman to data that are not normally distributed. Furthermore, CIMTwill be analyzed from the area under the curve (AUC) to get a cut point value associated with LV mass, LVMI and Relative wall thickness. Statistical data analysis using statistical software, the value of p <0.05 is said to be statistically significant.

RESULTS

In this study, 115 patients with hypertension who have met the inclusion

and exclusion criteria as research subjects. The whole subject of the research, found as many as 50 people (43.5%) who had CIMT ≤ 0.5, and 65 (56.5%) had CIMT> 0.5. Then the subjects were divided into two groups based on the value of CIMT.Table 1 shows the baseline characteristics of the study subjects were compared on demographic characteristics, risk factors, hemodynamic, laboratory results namely hemoglobin, urea and creatinine, history of treatment used and the characteristics of the subject ECG (axis and LVH with the criteria of Sokolow Lyon). Of the 115 study subjects, found 68 (59.1%) are women, more than men study subjects which 47 (40.9%).The mean age of subjects was 59 years in this study.

From clinical parameter, there are significant difference in duration of hypertension which is higher in group with CIMT > 0.5 mm compared to group with CIMT < 0.5 mm (5.1±3.2 vs. 7.7±4.4, p<0.001). The medications used by the patients include beta blockers, ACE inhibitors, calcium channel blockers, and also diuretics. The CCB was more commonly used in CIMT > 0.5 mm group, which was 27 patients (41.5%), compared with the other group for only 11 patient (p = 0.027).

Table 1.Baseline Characteristics of study subjects based on CIMT

Variables	CIMT ≤ 0.5 mm (n = 50)	CIMT> 0.5 mm (n = 65)	p value
Age (years±SD)	58.5±10.2	60.6±8.5	0.226
Gender (n,%)			0.549
Man	22 (44.0)	25 (38.5)	
Woman	28 (54.8)	40 (61.5)	
BMI (kg/m2, mean±SD)	25.9±4.2	26.3±3.5	0.302
Systolic BP (mmHg, mean±SD)	139.5±17.2	141.3±17.1	0.957
Diastolic BP (mmHg, mean±SD)	78.3±10.3	81.8±10.2	0.064
Duration of hypertension (n,%)	5.1±3.2	7.7±4.4	<0.001
Risk factors			
Diabetes mellitus (n,%)	11 (22)	19 (29.2)	0.381
Dyslipidemia (n,%)	17 (34)	18 (27.7)	0.466
Smoking (n,%)	21 (42)	25 (38.5)	0.701
Family History	16 (32)	31 (47.7)	0.090
Laboratorium			
Hemoglobin (mg / dL ± SD)	13.3±1.8	13.2±1.5	0.699
Urea (mg / dL ± SD)	30.3±19.9	31.6±19.7	0.771
Creatinine (mg / dL ± SD)	1.0±0:58	1.1±0.6	0.393
Medication (n,%)			
ACE-I / ARB	46 (92)	64 (98.5)	0.165
CCB	11 (22)	27 (41.5)	0.027
Diuretics	16 (32)	26 (40)	0.377
Beta blockers	39 (78)	45 (69.2)	0.293
Electrrocardiogram (ECG)			
Axis			<0.001
Normal	48 (96)	45 (69.2)	
LAD	2 (4)	20 (30.8)	
LVH Sokolow Lyon			0.174
Yes	6 (12)	3 (4.6)	
Not	44 (88)	62 (95.4)	

Table 1. Echocardiography Parameters based on CIMT

Variables	CIMT ≤ 0.5 mm (n = 50)	CIMT> 0.5 mm (n = 65)	p value
Ejection fraction (%, mean±SD)	63.9 ± 7.7	65.8 ± 7.6	0.168
IVSD (mm, mean±SD)	11.3 ± 2.5	13.7 ± 2.7	<0.001
LV EDD (mm, mean±SD)	43 ± 4.6	45.5 ± 5.1	0.006
LV PWD (mm, mean±SD)	10.3 ± 2.1	12.7 ± 2.3	<0.001
LAVI (mL/m2, mean±SD)	32.8 ± 3.5	33.4 ± 5.2	0.487
E (m/s, mean±SD)	0.74 ± 0.2	0.7 ± 0:16	0.184
e 'septal (cm/s, mean±SD)	7 (5-9)	6 (7-8)	0.003
e 'Lateral (cm/s, mean±SD)	10 (8-12)	8 (7-9)	0.001
E / e '(mean±SD)	8.9 ± 2.5	9.8 ± 2.5	0.036
RWT (mean±SD)	0:48 ± 0.1	0.6 ± 0.2	0.001
LVM (g, mean±SD)	165.1 ± 47.7	238.1 ± 60.1	<0.001
LVMI (g/m^2, mean±SD)	96.2 ± 26.2	138.7 ± 32.4	<0.001
Diastolic function (n,%)			0.003
Normal	46 (92)	45 (69.2)	
Disturbed	4 (8)	20 (30.8)	
LV geometry (n,%)			<0.001
Normal	12 (24)	1 (1.5)	
Concentric Remodeling	24 (48)	3 (4.6)	
Concentric Hypertrophy	10 (20)	56 (86.2)	
Eccentric Hypertrophy	4 (8)	5 (7.7)	

Based on echocardiography result, the mean ejection fraction was found in the group of CIMT ≤ 0.5 mm by 63.9% whereas in the group with CIMT> 0.5 mm found to be 65.8%, but not significantly different statistically. IVSD found to be higher in value in the group with CIMT> 0.5 mm compared to the other group that is 13.7 mm, p <0.001. LVEDD found to be higher in value in the group with CIMT> 0.5 mm compared to the other group that is 45.5 mm, with a value of p = 0.006. LVPWD found to be higher in value in the group with CIMT> 0.5 mm compared to the other group that is 12.7 mm, p <0.001.

The value of e 'septal had lower values in the group with CIMT> 0.5 mm compared to the other group that is 6 mm, with a value of p = 0.003. The value of e 'lateral had lower values in the group with CIMT> 0.5 mm compared to the other group that is 8 mm, with a value of p = 0.001. E / e 'found to be higher in value in the group with CIMT> 0.5 mm compared to the other group that is 9.8 mm, with a value of p = 0.036. LAVI value, the value of E was not statistically significantly different between the two groups. The whole subject of the research, found as many as 73 people (63.5%) experienced LVH and 42 (36.5%) had no LVH. The research subjects were then divided into two groups based on experience or not experience LVH. The first group is the research subjects did not experience or without LVH, while the second group is the subject of research experience or with LVH.

Table 3 shows the baseline characteristics of the study subjects were compared on demographic characteristics, risk factors, hemodynamic, medical history, ECG and echocardiography parameters. Of the 115 study subjects, found 68 (59.1%) are women, more than men study subjects which 47 (40.9%). Gender, age, BMI, systolic BP and diastolic BP between the two groups were not statistically different. Base on cardiovascular risk factors such as diabetes, dyslipidemia and smoking and family history also were not statistically different.

Duration of hypertension in the group without LVH found to be 5.6 years, while in the group with LVH found to be 7.1 years and this were statistically different (p = 0.003).

Table 2. Baseline Characteristics of Subjects based on LVH

Variables	Without LVH (n = 42)	With LVH (n = 73)	p value
Age (years ± SD)	59.3±10.7	59.9±8.5	0.729
Gender (n,%)			0.470
Man	19 (45.2)	28 (38.4)	
Woman	23 (54.8)	45 (61.6)	
BMI (kg/m^2, mean±SD)	26.3±4.5	26.0±3.5	0.687
Systolic BP (mmHg, mean±SD)	138.0±16.5	141.9±17.3	0.563
Diastolic BP (mmHg, mean±SD)	78.6±10.8	81.3±9.9	0.092
Duration of hypertension (n,%)	5.6±4.6	7.1±3.7	0.003
Risk Factors:			
Diabetes mellitus, (n,%)	10 (23.8)	19 (26)	0.792
Dyslipidemia (n,%)	15 (35.7)	20 (27.4)	0.351
Smoking (n,%)	20 (47.6)	26 (35.6)	0.206
Family history			
Medication (n,%)			
ACE-I / ARB	39 (92.9)	71 (97.3)	0.353
CCB	9 (21.4)	29 (39.7)	0.045
Diuretics	14 (33.3)	28 (38.4)	0.590
Beta blockers	33 (78.6)	51 (69.9)	0.311
ECG:			0.003
Axis Normal	40 (95.2)	53 (72.6)	
Axis LAD	2 (4.8)	20 (27.4)	
LVH (Sokolow Lyon)			0.152
Yes	1 (2.4)	8 (11)	
No	41 (97.6)	65 (89)	
LV ejection fraction (%, mean±SD)	66.5±7.5	62.3±7.3	0.004
IVSD (mm, mean±SD)	10.6±2.3	13.8±2.5	<0.001
LV EDD (mm, mean±SD)	42.4±4.4	45.6±4.9	0.001
LV PWD (mm, mean±SD)	9.9±1.9	12.7±2.2	<0.001
LVMI (g/m^2, mean±SD)	85.4±1.4	140.2±29.1	<0.001
RWT	0.47±0.1	0:56±0.1	0.001
CIMT			<0.001
> 0.5	4 (9.5)	61 (83.6)	
≤ 0.5	38 (90.5)	12 (16.4)	

A CCB was also found to be more widely used in the group with the LVH in 29 (39.7%) than in the group without LVH ie in 9 (21.4%), this differs statistically significant (p = 0.045). The use of ACE-I/ARB, diuretics and beta-blockers were found between the two groups did not differ statistically significant.

Based on the characteristics of the ECG parameters, of 115 people found 93 research subjects with normal QRS axis and 22 people with different axis LAD and statistically significant (p = 0.003)

Based on echocardiography results, the mean ejection fraction was found in the group without LVH amounted to 66.5% whereas in the group with LVH found to be 62.3%, this is significantly different between the two groups (p = 0.004). IVSD found to be higher in value in the group with than without LVH namely 13.8 mm (p <0.001). LV EDD found to be higher in value in the group with than without LVHLVH namely 45.6 mm (p = 0.001). LV PWD found to be higher in value in the group with no LVHLVH than 12,5 mm(p <0.001).

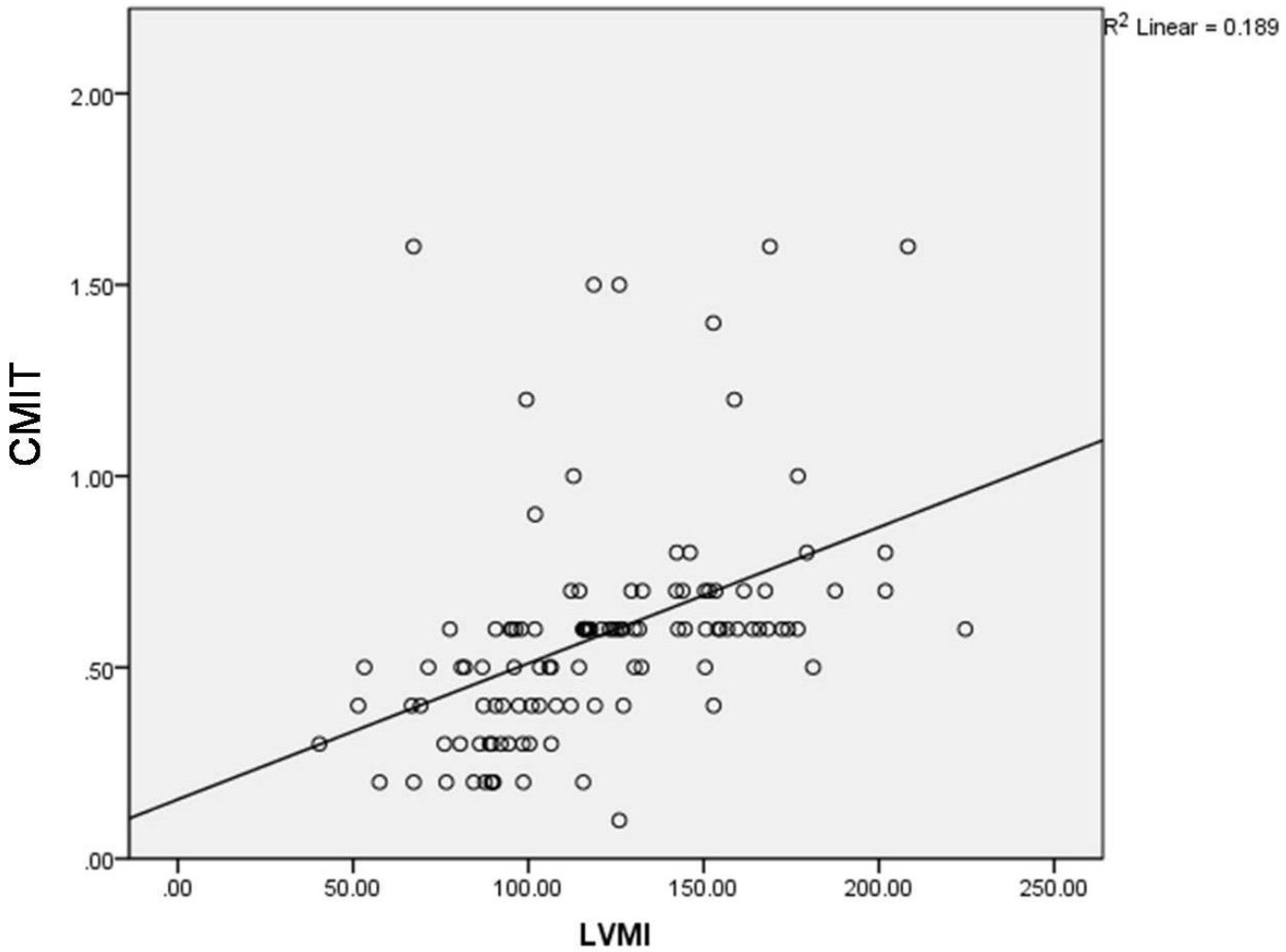

Figure 1.Scatter plot graph shows correlation between CIMT (mm) and LVMI (g/m^2)

The LVMI mean in the group without LVH found to be 85.4 g/m2, whereas in the group with LVH found to be 140.2 g/m2. It is a significant difference (p <0.001). RWT mean in the group without LVH found to 0:47 LVH of the control group was found to 0:56, this differs statistically significant (p = 0.001).

To assess the correlation between CIMT obtained from ultrasound with LVH, RWT, LVM, LVMI from echocardiography, we performed Spearman analysis. The results of the correlation test showed a significant proportional relationship between CIMTand LVMI with the strongest correlation (r = 0.618, p <0.001) among other variables (figure 1).

Analysis of diagnostic test CIMT with LVH in patients with hypertension found that CIMT had a sensitivity of 83.6%, specificity 90.4%, PPV 76% and NPV of 93.8% for diagnosing LVH. By using the ROC curve, it can be assessed area under the curve (AUC) of CIMT, which will demonstrate the ability CIMT as LVH markers in patients with hypertension. In this study we found AUC 0.90 with p value <0.001. This indicates that the value of CIMT clinically meaningful as a marker of LVH in patients with hypertension. The cut-off point >0.55 mm is considered to determineLVH with a sensitivity of 83.6% and a specificity of 90.5% (figure 2).

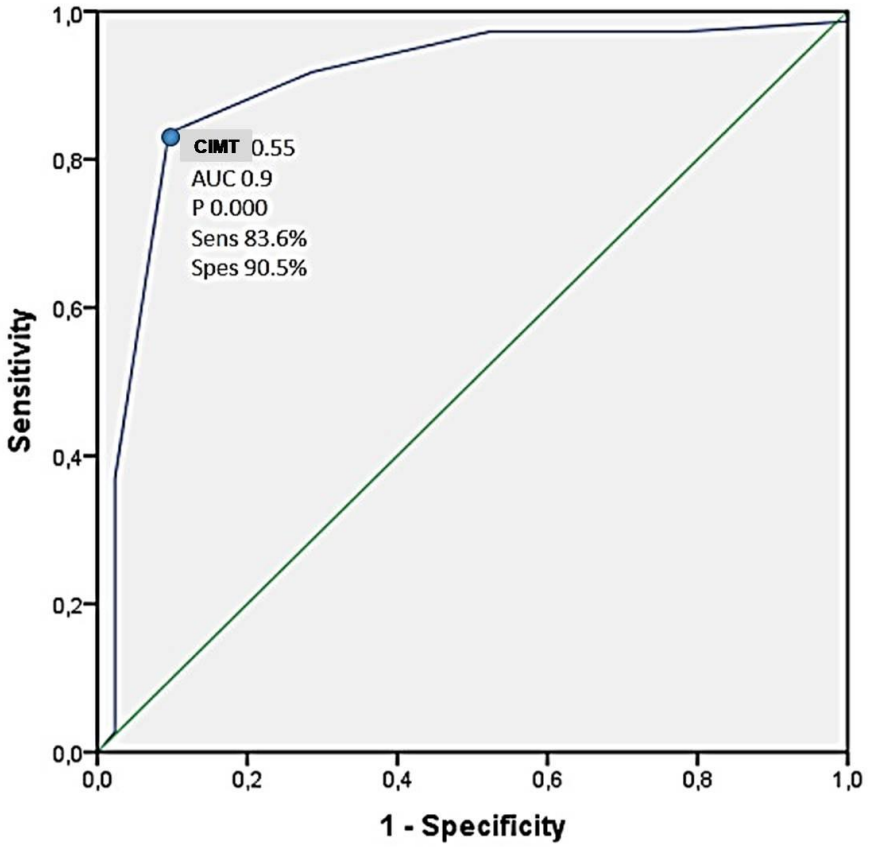

Figure 2.An ROC curve of CIMT

DISCUSSION

This study is a cross-sectional study aimed to assess the relationship between carotid intima-media thickness (CIMT) andleft ventricular hypertrophy (LVH) and get CIMT cut-off point value that can be used to determineLVH in hypertensive patients. Assessment of LVH, is important because these changes are a natural course of hypertension that occurs and rarely causes clinical symptoms in patients so that it is rarely a concern in terms of management. An LVH assessment in this cas LVMI by using echocardiography is still considered a non-invasive examination that is quite expensive so it is expected that CIMT examination using ultrasound can be a convenient, easy non-invasive examination that can be done widely in other health facilities.

Based on the characteristics of the study subjects, showed that most of the samples were female as many as 68 people, although not significantly different between groups CIMT>0.5 mm orCIMT ≤ 0.5 mm as well as in the group with or without LVH. This is consistent with the data the proportion of patients with hypertension in the our hospital committed by the Putri SD et al. that the majority of patients with hypertension in our hospital are women.[7] This result thought to be influenced by the adaptation process of remodeling caused by hypertension unfavorable to women, making it easier hypertrophy and stiffness of the left ventricle.[8] The average age between the two groups based CIMT and LVH roughly 59 years.These results are also not much different from previous studies with mean age between 57-60 years.[7]

In this study, there is a significant difference between the groups about the duration of hypertension subjects based CIMT and LVH. The duration of hypertension between the two study groups were found statistically different, with a mean of 5.1 years in the group CIMT ≤0.5 mm and 7.7 in group CIMT >0.5 mm, 5.6 years in the group without LVH and 7.1 years in the group with LVH. This is consistent with the statement of the European Association of Cardiovascular Imaging (EACVI) and the American Society of Echocardiography (ASE), which stated the LVH in hypertensive patients related to the duration of hypertension and uncontrolled hypertension.[9] The longer a person has hypertension, it will be increasingly at risk of LVH. However, in this study also found four research subjects in the group without hypertension long LVH with more than 10 years (ie, 12 years, 15 years, 20 years and 23 years). It is alleged because the study subjects with hypertension were controlled, so that even after a long time had hypertension but did not experience LVH.

In this study was found in the group of CIMT more use of antihypertensive therapy class of ACE-I or ARB and beta blockers compared to diuretics and CCB ie> 92% and> 69%. According to some research done to determine the hypertension drug that can reduce CIMT showed that ACE-I or ARB can reduce CIMT in hypertensive patients in which ACE-I or ARB has the effect of inhibiting the hypertrophy of vascular and atherosclerosis by inhibiting the growth of smooth muscle in blood vessels and lowering intimal lesion formation.[10] A study conducted by Tropeano et al mention that the combined use of CCB with an ARB / ACE-I significantly decreased the CIMT when compared to the use of diuretics alone.[11]

In the study also found most of the study subjects using antihypertensive therapy class of ACE-I or ARB, which amounted to 92.9% in the group without LVH and 97.3% in the group with LVH. While the CCB class of antihypertensive use more widely used in the group with LVH, which amounted to 39.7% versus 21.4% in the group without LVH (p = 0.045).

In this study found a positive relationship between CIMT with LVH, RWT, LVM, LVMI with the strength of the correlation of each of 0.484, 0.364, 0.594 and 0.618. This is consistent with research Cuspidi et al. found that there is a relationship between CIMT and LVMI where an increase in LVMI on improving CIMT (LVMI 106±7 vs. 98±12 g/m^2, p >0.05; CIMT 0.68 vs 0.61 ± 0.13mm ± 0.1mm, P <0:05).[2] Kaunang et al. found also found that there is a positive relationship between CIMT with LVM in obese adolescents.[12] In a study conducted by Linhart et al. found a correlation between CIMT with LV mass (r = 0:54, p <0.001).[3] Correlation values between CIMT with LVM in this study was not much different.

In this study it was found that CIMT> 0.5 mm had a sensitivity of 83.6%, specificity 90.4%, NPV 76% and PPV 93.8% for diagnosing LVH so it can be concluded that the value of CIMT have capacities well as the modalities of screening in patients with hypertension to see whether there LVH as subclinical TOD. Then, based on this research subject search new cut point value using ROC curves, it can be judged Area Under the Curve (AUC) of CIMT, which will demonstrate the ability CIMT in diagnosing patients in our hospital. In this study found AUC 0.90 with p value <0.001. This indicates that the value of the CIMT both clinically meaningful in diagnosing LVH in hypertension patients with Value cutoff point was found to> 0.55 mm.

CONCLUSION

There is a positive correlation between carotid intima-media thickness with left ventricular hypertrophy in hypertensive patients. CIMT ultrasound examination is expected to be useful for physicians and other health centers to diagnose LVH by echocardiography in patients with hypertension, especially where ultrasound is

still an option and is not available yet echocardiography.

REFERENCES

1. Campbell N.R., Lackland D.T., Niebylski M.L. 2014. high blood pressure: why prevention and control are urgent and important—a 2014 fact sheet from the world hypertension league and the International Society of Hypertension. J Clin Hyperten, 16:551-553.
2. Cuspidi C., Lonati L., Sampieri L., Pelizzoli S., Pontiggia G., Leonetti G., et al. 1996. Left ventricular concentric remodelling and carotid structural changes in essential hypertension. J Hypertens, 14:1441-1446.
3. Linhart A., Gariepy J., Giral P., Levenson J., Simon A.1996. Carotid artery and left ventricular structural relationship in asymptomatic men at risk for cardiovacular disease. atherosclerosis. Atherosclerosis, 127:103-112.
4. Evensen K., Sarvari S.I., Rønning O.M., Edvardsen T., Russell D. 2014. Carotid artery intima-media thickness is closely related to impaired left ventricular function in patients with coronary artery disease: a single-centre, blinded, non-randomized study.Cardiovasc Ultrasound, 12:39.
5. Unger T., Paulis L., Sica D.A. 2011. Therapeutic perspectives in hypertension: novel means for renin–angiotensin–aldosterone system modulation and emerging device-based approaches. Eur Heart J, 32:2739-2747.
6. Jarauta E., Mateo-Gallego R., Bea A., Burillo E., Calmarza P., Civeira F. 2010. Carotid intima-media thickness in subjects with no cardiovascular risk factors. Rev Esp Cardiol, 63:97-102.
7. Putri D.S., Hasan H., Hasan R., Siregar A, Akbar N, Andra CA. 2018. Peran Nilai Interval QT Terkoreksi dari Elektrokardiografi sebagai Penanda Disfungsi Diastolik VentrikelKiri. Tesis ProfesiJantungdanPembuluhDarah FK USU. Medan, Indonesia
8. Bartels S., Franco A.R., Rundek T. 2012. Carotid intima-media thickness (CIMT) and plaque from risk assesment and clinical use to genetic discoveries. Perspectives in Medicine, 1:139-145.
9. Marwick T.H., Gillebert T.C., Aurigemma G., Chirinos J., Derumeaux G., Galderisi M., et al. 2015. Recommendations on the use of echocardiography in adult hypertension: a report from the European Association of Cardiovascular Imaging (EACVI) and the American Society of Echocardiography (ASE). J Am Soc Echocardiog, 28:727-754.
10. Patel M.K., Betteridge L.J., Hughes A.D.,Clunn GF, Schachter M, Shaw RJ, et al. 1996. Effect of angiotension II on the expression of the early growth response gene c-fos and DNA synthesis in human vascular smooth muscle cells. J Hypertens, 14:341–347.
11. Tropeano A.I., Saleh N., Hawajri, Macquin-Mavier I., Maison P. 2011. Do all antihypertensive drugs improve carotid intima-media thickness?: A network meta-analysis of randomized controlled trials. Fundam Clin Pharmacol, 25:395-404.
12. Kaunang D., Irna C., Stefanus G. 2015. Hubungan ketebalan intima media arteri karotis dan massa ventrikel kiri pada remaja obese. Sari Pediatri, 17:249-254.