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Correlation between Left Ventricular Hypertrophy with Strain Pattern Electrocardiography and Left Ventricular Diastolic Dysfunction in Hypertensive Heart Disease

Omar M. Siregar^{*1}, Nizam Z. Akbar¹, Zainal Safri¹, Harris Hasan¹, Zulfikri Mukhtar¹, T. Bob Haykal¹

¹Department of Cardiology and Vascular Medicine, University of Sumatera Utara, Adam Malik General Hospital, Medan, Indonesia

Abstract : Background : Left ventricular hypertrophy ECG with 'strain' pattern will show indirectly structural and functional change in hypertensive patients, this process leads to diastolic dysfunction that eventually will be heart failure, this study aims to seek a correlation between ECG with 'strain' pattern with diastolic dysfunction in echocardiography examination in patients with hypertensive heart disease. Method : This is a cross-sectional study involving 80 patients diagnosed with hypertension in Haji Adam Malik General Hospital Medan from Mei 2018 to August 2018. Chi-Square test will be performed to analyze correlation between ECG with 'strain' pattern with diastolic dysfunction in patients with normal ejection fraction according to *ASE 2016 guidelines* in hypertensive heart disease patients.

Result : From 80 subjects, 12 (80%) subjects with 'strain' pattern ECG have diastolic dysfunction (p=0.001). subjects with history of smoker and diabetes mellitus has significant correlation to diastolic dysfunction (p=0,049 & p=0,047). LAD axis, e' septal value, LAVi, TR velocity values has also significant correlation to diastolic dysfunction in hypertensive heart disease patient (p<0.05).

Conclusion : Left ventricular hypertrophy ECG with 'strain' pattern has correlation with diastolic dysfunction in echocardiography performed in patients with hypertensive heart disease. Smokers and diabetes mellitus patients also correlated with diastolic dysfunction in hypertensive heart disease patient.

Introduction

Without any symptoms in the early hypertension, it is difficult to diagnose patients who has hypertension, especially in the low-income population.¹ Annually hypertension cost about 3.6 trillion US dollar globally.²

Electrocardiography has a role as the initial diagnostic instrument to indirectly assess any anatomical or physiological change in the heart of hypertesive patients although the electrocardiography has a low sensitivity

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in detecting a ventricular hypertrophy but the Sokolow-Lyon index criteria alongside with the modified Sokolow-Lyon index and Cornell criteria has proven to be a strong predictor at predicting cardiovascular event in observational and clinical studies. Strain pattern shows that a hypertensive patients has a worse risk for cardiovascular event and an atrial dilataion. This 12-lead ECG examination will become more significant with patients over 55 years old.^{3,4,5,6}

Diagnostically left ventricle hypertrophy shows that there is a volume and pressure overload in the left ventricle and from prognostic point of view, patients with left ventricle hypertrophy had a higher risk to develop heart failure and arrhytmia.⁷LVH will affect the diastolic function of left ventricle.⁸

Hypertensive heart disease are developed from a chronic untreated hypertension that characterized by a change in the cardiovascular structure and myocardial function without any other primer cause from cardiovascular.⁹

American society of echocardiography (ASE) guidelines for Echocardiography diastolic function measurements in patient with a normal ejection fraction are updated in 2016, it has 4 main variable (e' lateral/septal velocity, *LAVi*, mean E/e' peak TR velocity) that will assess whether the patient had a diastolic function or not. If more than half of this variable are met, the patients will diagnosed with diastolic dysfunction.¹⁰

This study aims to assess a correlation between strain pattern ECG with diastolic dysfunction in patient with hypertension. There are no known previous study that correlates between strain pattern and the diastolic function as mentioned in the 2016 ASE guidelines for diastolic dysfunction with normal ejection fraction. The result of this study might be used to rapidly diagnose and treat hypertensive patients with diastolic dysfunction.

Methods

This cross-sectional study included 80 consecutive patients diagnosed with hypertension that came to the out-patient cardiovascular clinic in Haji Adam Malik General Hospital in Medan from May 2018 to August 2018 inclusion criteria are patients diagnosed with hypertension, hypertension defined as sistolic blood pressure \geq 140 mmHg and/or diastolic pressure \geq 90 mmHg. Hypertensive patients without atrial fibrilation, acute coronary syndrome, regional wall motion abnormality, ejection fraction >50% are also included, patients with poor echo window are excluded in this study. All patients are already treated with anti hypertensive drugs, history taking about risk factor (smoking, obesity), ECG, chest X-ray are taken before patients underwent the echocardiography examination

The patients are divided into 2 groups based on whether the strain pattern found on the ECG or not then the echocardiography examination are performed to assess diastolic dysfunction.

Statistical Analysis

All statistical analyseswere carried out using the SPSS statistical software, version 19.0. The data were presented withmean \pm SD or median and interquartile range for continuous variables. Categorical variables presented as percentage. The normality test for continuous variables in all study subjects using one sample Kolmogorov Smirnov (n> 50). In continuous variables compared with two free samples T test (Two Samples Independent Student's t-test) on normal distributed data or Mann Whitney U Test if the data is not normally distributed. In categorical variables, an analytical test is performed using chi squared or fisher exact tests. The p value < 0.05 was considered as statistically significant.

Result

A total of 80 patients who met the inclusion and exclusion criteria are divided into 2 groups based on the ECG strain pattern finding. There were 17 patients (21.3%) with strain pattern ECG and 63 patients (78.8%) without strain pattern ECG.

In this study 48 subjects are female (60%) and the average age for the subjects are 60 years old, 41 (51.3%) subjects are categorized as obese, 13 subjects(16.3%) with diabetes type 2 and 13 subjects (21.3%) are smokers.

30 subjects (37.5%) are in stage 1 hypertension, 28 subjects (35.0%) in pre-hypertension and 9 subjects (11.3%) in stage 2 hypertension while 13 subjects (16.3%) had normal blood pressure during study (Table 1).

Table 1. Baseline clinical characteristic of subject study

Total Subject	N=80 (100%)
Gender	
Male	32 (40,0%)
Female	48 (60,0%)
Age (Year), Mean±S.D ^a	60,76±8,828
Smoking History	
Yes	17 (21,3%)
No	63 (78,8%)
Diabetes Type 2	
Yes	13 (16,3%)
No	67 (83,7%)
Body Mass Index	
Normal	16 (20,0%)
Underweight	1 (1,3%)
Overweight	22 (27,5%)
Obesity	41 (51,3%)
Duration of Hypertension (Tahun), Median (Min-Maks) ^b	5 (1 – 15)
Hypertension	
Normal	13 (16,3%)
Pre-Hypertension	28 (35,0%)
Hypertension Stage 1	30 (37,5%)
Hypertension Stage 2	9 (11,3%)
Sistolic Blood Pressure (mmHg), Median (Min-Maks)	140 (110 – 190)
Diastolic Blood Pressure (mmHg), Median (Min-Maks)	80 (40 - 100)
Axis	
Normal	68 (85,0%)
LAD	11 (13.8%)
RAD	1 (1,3%)
LV Strain ECG	
Yes	17 (21.3%)
No	63 (78.8%)
Diastolic Dysfunction	
50 % (No Diastolic Dysfunction)	65 (81 3%)
>50% (Diastolic Dysfunction)	15 (18.8%)
LV mass	
Moderate	1 (1 3%)
Severe	79 (98.8%)
EF Teich Median (Min-Maks)	69.50(53-79)
F/e' Mean+S D	8 660+0 335
F' Sental Median (Min-Maks)	0.070(0.04 - 0.90)
F' I ateral Median (Min-Maks)	0.090(0.05 - 0.90)
TR Velocity Median (Min-Make)	2,200(1,35-3,30)
L AVi Median (Min Maks)	2,200(1,33-3,30) 278 18(130 63 402 81)
LA VI, Median (Mini-Maks)	2/0,10(130,03-402,81)

In this study statistic analysis shows that subject with smoking history and diabetes type 2 has a strong correlation with diastolic dysfunction (p=0.049 & p=0.047). Left axis defiation (LAD) in ECG also has a correlation with diastolic dysfunction (p=0.004), from echocardiography finding a Mann-Whitney test was performed to *e' septal*(p=0.021), TR velocity (p=0.001) and LAVi (0.001) shows that a decreased of *e' septal*, increased TR velocity and increase LAVi have a significant correlation with diastolic dysfunction (Table 2).

		Fungsi Diastolik				_
		50%		>50%		
		(No	Diastolic	(Diastolic		р
		Dysfunction)		Dysfunction)		
		n	%	Ν	%	
Gender	Male	26	40,0%	6	40,0%	1 000 ^a
	Female	39	60,0%	9	60,0%	1,000
Age (Year)		61,26±1,038		58,60±2,750		0,517 ^d
Smoking History	Yes	11	16,9%	6	40,0%	0.049 ^a
	No	54	83,1%	9	78,8%	0,047
Diabetes Type 2	Yes	9	13,8%	4	26,7%	0.047 ^b
	No	56	86,2%	10	66,7%	0,047
Body Mass Index	Normal	14	21,5%	2	13,3%	
	Underweight	1	1,5%	0	0,0%	0.820 ^b
	Overwieght	17	26,2%	5	33,3%	0,829
	Obesity	33	50,8%	8	53,3%	
Hypertension Duration		5,45±0,472		6,67±0,297		0,099 ^d
Sistolic Blood Pressure		137,29±1,863		144,33±4,366		0,153 ^d
Diastolic Blood Pressure		81,12±1,184		82,67±2,341		0,641 ^d
Hypertension Stage	Normal	10	15,4%	3	20,0%	
	Pre-HT	26	40,0%	2	13,3%	0.087 ^a
	HT-1	24	36,9%	6	40,0%	0,087
	HT-2	5	7,7%	4	26,7%	
Axis	Normal	59	90,8%	9	60,0%	
	LAD	5	7,7%	6	40,0%	0,004 ^b
	RAD	1	1,5%	0	0,0%	
LV mass	Moderate	1	1,5%	0	0,05	1 000 ^b
	Severe	64	98,5%	15	100,0%	1,000
E/e'		8,459±0,330		9,530±1,073		0,214 ^c
EF Teich		68,60±0,928		66,33±1,460		0,132 ^d
E' Septal		0,099±0,015		0,100±0,035		0,021 ^d
E' Lateral		0,093±0,003		0,135±0,054		0,225 ^d
TR Velocity		2,140±0,035		2,960±0,032		0,001 ^d
LAVi		261,142±8,007		342,829±15,909		0,001 ^d

Table 2. Correlation between subjects baseline characteristic with diastolic dysfunction

Note : a. chi-square test, b. Fisher Exact Test, c. Mann-Whitney Test

Bivariat analysis was performed using Chi-Square test and it shows that ECG with strain pattern in hypertensive heart disease subjects shows statistically significant correlation with Diastolic dysfunction (p=0.001) (Table. 3).

Fungsi Diastolik		
50%	>50%	p
(No Diastolic	(Diastolic	

		Dysfunction)		Dysfunction)		
		Ν	%	n	%	
LV Strain ECG	Yes	5	7,7%	12	80,0%	
	No	60	92,3%	3	20,0%	0,001 ^a
	Total	65	100,0%	15	100,0%	

Note : a. Chi-Square Test

During this study a Fisher Exact test was also performed to analyze correlation between strain pattern in ECG with increased LV mass, the statistical result shows there was no correlation between ECG with strain pattern with increased LV mass in hypertensive heart disease subjects (table 4).

Table 4. Correlation between LV strain ECG and LV mass index

	LV Mass					
		Moderate		Severe		p
		n	%	n	%	
Strain Pattern ECG	Yes	0	0,0%	17	21,5%	
	No	1	100,0%	62	78,5%	0,488 ^b
	Total	1	100,0%	79	100,0%	

Note : b. Fisher Exact Test

Discussion

In this study more than half of the subjects are overweight/obese this finding are supported by previous theory about the relationship between hypertension in overweight/obese patients the mechanism includes (1) direct fat compression to the kidneys (2) RAS activation due to fat compression in kidneys (3) increased symphatetic response.¹¹

Previous study also support the finding that smoking correlates with diastolic dysfunction in hypertension patients.¹²

Diabetes tpye 2 also correlates with diastolic dysfunction as this finding was previously found in other studies that concludes that patients that had more than 5 year of Diabetes type 2 and normal ejection fraction are associated with diastolic dysfunction in echocardiographic examination.¹³

In this study there is a significant statistic result that shows a Left Axis Deviation is correlated with diastolic dysfunction, this finding should be carefully interpreted in hypertensive heart disease patients since this ECG finding cannot used as a diagnostic tools and that LAD are not an independent variable to diagnose left ventricular hypertrofi and also LAD also featured in other conditions like conduction problems.¹⁴

High value in LAVi in this study shows a correlation with diastolic dysfunction although the statistically the subjects are not distributed normally but another study conducted by Pritchett et al.(2005),¹⁵ with a larger subjects involved shows similiar results in LAVi value and its strong correlation with diastolic dysfunction and heart failure.

In this study strain pattern in ECG shows a strong correlation with diastolic dysfunction in echocardiography finding as directed in 2016 american society of echocardiography guidelines, this result although looks promising as a simple tools quickly diagnose and even treat patients based only by ECG findings needs more subjects to be involved since there was no previous study that support this study.

Previously Okin et al (2001),¹⁶ conducted a study that show a correlation of increased LV mass index in patients with Strain pattern ECG this results was contrary to this study but it may be due to the fact that the subjects are all hypertensive heart disease patients that already had increased LV mass index.

Study Limitation

The limitations of this study include the number of samples of this study is smaller than similiar previous studies and only carried out in one center so that further research needs to be done with a larger number of samples and multicenter.

Conclusion

Left ventricular hypertrophy with strain pattern found in electrocardiography has a strong correlation with diastolic dsyfunction in hypertensive heart disease patients (p<0.001).

References

- 1. Ibrahim MM, Damasceno A. 2012. Hypertension in developing countries. Lancet 380:611.
- 2. Gaziano TA, Bitton A, Anand S, et al. 2009. The global cost of nonoptimal blood pressure. J Hypertens 27:1472. 2009.
- 3. Levy D, Salomon M, D'Agostino RB, et al. 1994. Prognostic implications of baseline electrocardiographic features and their serial changes in subjects with left ventricular hypertrophy. Circulation 1994;90:1786.
- 4. Okin PM, Devereux RB, Jern S, et al. 2004. Regression of electrocardiographic left ventricular hypertrophy during antihypertensive treatment and the prediction of major cardiovascular events. JAMA 2004;292: 2343 2349.
- Fagard RH, Staessen JA, Thijs L, Celis H, Et al. 2004. Prognostic significance of electrocardiographic voltages and their serial changes in elderly with systolic hyper- tension. Hypertension 2004;44:459 – 464.
- Okin PM, Oikarinen L, Viitasalo M, et al. 2009. Prognostic value of changes in the electrocardiographic strain pattern during antihypertensive treatment: the Losartan Intervention for End-Point Reduction in Hypertension Study (LIFE). Circulation 2009;119: 1883 – 1891.
- 7. Goldberger AL. 2006. Clinical Electrocardiography a Simplified Approach 7th Edition. Missouri, Mosby.
- 8. Palmieri V, Okin PM, Bella JN, et al. 2006. Electrocardiographic pattern and left ventricular diastolic function in hypertensive patients with left ventricular hypertrophy : the LIFE study. J hypertens 2006. 24(10) : 2079-2084.
- 9. Georgiopoulou VV, Kalogeropolous AP, Raggi P, et al. 2010. Prevention, diagnosis and treatment of hypertensive heart disease. Cardiol-Clin 2010. 28: 675-691.
- 10. Nagueh SF, Smiseth OA, Appleton CP, et al. 2016 ASE/EACVI guidelines and standards recommendations for the evaluation of left ventricular diastolic function by echocardiography : an update from the american society of echocardiography and the european association of cardiovascular imanging. J am Soc Echocardiogr 2016. 29:277-314.
- 11. Hall JE, do Carmo JM, da Silva AA, dkk. 2015. Obesity-Induced Hypertension. AHA journal. Circulation Research 2015 ;116(6) 991-1006.
- 12. Alsheri AM, Azoz AM, Shaheen HA, et al. 2013 Acute Effects of Cigarette Smoking on the Cardiac Diastolic Functions. Journal of the Saudi Heart Association 2013. 25 (3) : 173-179
- 13. Patel VC, Shah KB, Vasani JD, et al. 2011. Diastolic Dysfuntion in asymptomatic type 2 diabetes mellitus with normal systolic function. JCDR 2011. 2(4) : 213-222
- 14. Hancock EW, Deal BJ, Mirvis DM, et al. 2009. AHA/ACCF/HRS Recommendations for the standardization and Interpretation of the Electrocardiogram. JACC 2009. 53: 992-999
- 15. Pritchett AM, Mahoney DW, Jacobsen SJ, et al. Diastolic Dysfunction and left atrial volume: a population based study. 2005. J Am Coll Cardiol 2005. 45(1): 87-92
- 16. Okin PM, Devereux RB, Nieminen MS. Relationship of electrocardiographic strain pattern tol left ventricular structure and function in hypertensive patients: the LIFE study. JACC 2001.38(2): 514-520.