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RELATIONSHIP BETWEEN HYPERTENSION AND LEFT VENTRICULAR HYPERTROPHY: A CLINICAL STUDY DONE AT A TERTIARY CARE CENTRE

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ABSTRACT
Hypertension is one of the leading risk factor for cardiac diseases. High blood pressure (hypertension) is one of the leading cause of death, causing over 7.5 million deaths and 57 million cases of disability all over the world. It manifests through entire organ systems, including the heart it self. Features of hypertensive heart disease include left ventricular hypertrophy, diastolic and systolic heart failure. As the law of Laplace suggests, left ventricular hypertrophy (LVH) is meant to encompensate excessive systemic blood pressure. Hence, this study was conducted in order to investigate the relationship of hypertension with incidence of left ventricle hyperthrophy on clinical basis. This study is a cross sectional study, involving 50 patients from a Tertiary Care Centre in Medan Indonesia and using secondary data gained from patients medical record. Only LVH diagnosed by means of echocardiography wast taken into consideration and used in this study, considering that echocardiography is the gold standard of LVH diagnosis. Statistical analysis was conducted using *Chi – square*. In this study, we found that 85.7% of patients with hypertension develop LVH and that hypertension showed significant relationship to the incidence of LVH ($p = 0.003 < p = 0.05$). Further analysis with ANOVA showed that hypertension class has no significant correlation with the incidence of LVH $p = 0.229$ ($p > 0.05$), thus indicating that there is no proven consistency between hypertension class and LVH.

KEYWORDS: *Hypertension, LVH, echocardiography, Laplace's law.*

INTRODUCTION
All over the world, hypertension is still causing multiple health problems, particularly due to the fact that hypertension appears without prominent symptoms at its early stage. Through time, it will interfere entire organ systems, including the heart itself and finally cause death.[1] It is postulated that the heart itself is not passive in terms of encountering increased hemodynamic pressure due to hypertension. There are at least 3 mechanism that the heart will develop to compensate increased hemodynamic pressure; increasing contractility (Frank-Starling), thickening of myocardium (Laplace's law) and increasing contractility through hormonal pathway. First mechanism is limited to the myocardium itself and hormonal involvement only takes place at final stage, thus thickening of myocardium contributes larger portion of adaptation mechanism by the heart in order to lower ventricular wall stress due to increased hemodynamic pressure.[2,3] Therefore, this study was conducted in order to investigate the relationship of hypertension with incidence of left ventricle hyperthrophy on clinical basis.

MATERIALS AND METHODS
This study is a cross sectional study, involving 50 inward patients from H. Adam Malik General Hospital Medan Indonesia and using secondary data gained from patients medical record. Only LVH diagnosed by means of echocardiography which is used in this study, considering that echocardiography is the gold standard of LVH diagnosis. Statistical analysis was conducted using *Chi – square*. Hypertension is defined as blood pressure of $\geq$ 140/90 mmHg and is classified according to JNC VII classification. Left ventricular hyperthrophy is defined as, left ventricular mass index (LVMI) of > 131 g/m^2 in male and > 108 g/m^2 in female which has been confirmed by echocardiography. Patients less than 40 years of age and have history of congenital heart disease are excluded from the study.

RESULTS AND DISCUSSION
In our study, we found that the number of male patients (n=37, 74%) exceeds and almost double the number of female patients (n=13, 26%) **(Table 1)**.

Table 1. LVH distribution according to gender

Gender	n	Percentage
Male	37	74%
Female	13	26%
Total	**50**	**100%**

In a study conducted by Damaiyanti S et al, they too has got the same characteristic as our study i.e males exceeds the number of females. [4] In a similar study conducted by Yousuf S et al on global burden of cardiovascular diseases stated that by 2020, the mortality rate of cardiovascular diseases in male may increase upto 48%, two times higher than in females.[5] Cardiovascular diseases (CVDs) are considered more common in male. In a study conducted by Connor et al and Miller R et al, it is postulated to have association with unhealthier lifestyle of men (higher stress, higher consumption of alcohol and smoking cigars) as well as the fact that men pay less attention to healthy diet including routine consumption of vegetables and fruits.[6,7] Women are considered more fortunate due to oestrogen which naturally lessen the risk of women getting CVDs.[8] In a study conducted by Wellman GC et al, they explained that oestrogen enhance nitric oxide (NO) production by the vascular endothelium probably through enhaced production of enzyme NO synthase.[29] In a similar study conducted by Julian et al, it was shown that through population of above 45 years of age, risk of getting CVD in both men and women is close to 1.5 : 1.[9] This suggests that degenerative process, lifestyle, and baseline condition in each gender contribute to larger proportion regarding how more likely an individual to get CVDs.[10]

In present study majority of patients are between ages 50 and 58 years of age (34%) and fewer patients were found in higher age groups (**Table 2**).

Table 2. LVH distribution according to age group

Age group (years)	n	Percentage
41 – 49	6	12%
50 – 58	17	34%
59 – 67	15	30%
68 – 76	8	16%
77 – 87	3	6%
88 – 96	1	2%
Total	**50**	**100%**

31 patients (62%) had hypertension and only 6 patients among them (19.4%) appeared with normal blood pressure with Left ventricular hypertrophy at time of examination (**Table 3**).

Table 3. Frequency of hypertension among patients

	Blood pressure measurment		Total
	HTN	Not HTN	
With Hypertension	25	6	31
Without hypertension	0	19	19

This indicates that over 80% patients with hypertension failed to achieve controlled blood pressure as planned. Hypertensive patients indeed are unbable to control disease progress. In a similar study conducted by Andromeda A et al, their data also showed that among 40 hypertension patients, 62.5% of patients had uncontrolled hypertension same as our study.[11]

In general, hypertensive patients which reported to routinely attend medication in community health center in Indonesia only accounts for 22.8%, meanwhile the other 77.2% do not report rountinely as studied by Hajjar I et al.[12] In a studies conducted by Wang TJ et al, Hyman et al, Amira CO et al and Mc Niece et al for patients who do not routinely attend medication, 91% had uncontrolled hypertension. While this might be correlated to patients knowledge and awareness, in fact other factors, particularly financial issues and difficult access to health care service and medications also play a critical role. The fact that hypertension is becoming more difficult to control is also related to individual factors, such as BMI, lipid profile, dietary habit and daily physical activity engaged by patients.[13],[14],[15],[16],[17] Our data also showed that majority of patients had hypertension grade I (36%). This grading is done according to guidelines given by Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC 7) (**Table 4**).

Table 4. Blood pressure classification based on JNC VII

Blood pressure	n	Percentage
Normal	15	30%
Pre HTN	8	16%
Hypertension grade I	18	36%
Hypertension grade II	9	18%
Total	**50**	**100%**

21 hypertensive patients out of 50 (42%) had LVH whereas remaining 29 (58%) where hypertensive without LVH. (**Table 5**).

Table 5. Frequency of LVH among patients

	n	Percentage
With LVH	21	42 %
Without LVH	29	58 %
Total	**50**	**100%**

Furthermore we studied the relationship between hypertension class with LVH (**Fig. 1**) which showed that LVH is found higher in patients with lower blood pressure compared to those classiefied as pre-hypertension. Inversely, patients without LVH were found to have higher blood pressure. These data seemed confusing and misleading so that we attempted to investigate it further. Further analysis with ANOVA showed that hypertension class has no significant correlation with the incidence of LVH $p = 0.229$ ($p > 0.05$), thus indicating that there is no proven consistency between hypertension class and LVH or in otherwords, it

can not be stated that individual with worse hypertension class will eventually develop LVH.

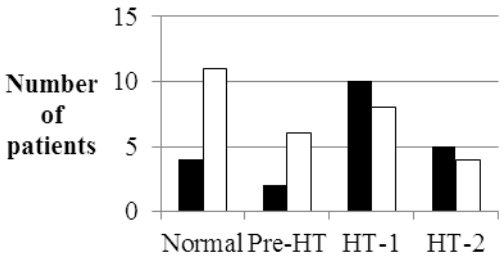

Fig. 1. Distribution of LVH based on hypertension class(with LVH, without LVH)

We admit that this result is actually far from what we expected. We previously expected that higher hypertension class will proportionally correlated with increased incidence of LVH. But we realize that the use of secondary data may limit the accuracy of this study itself. It is worth noted that blood pressure recorded in this study was taken from random/ casual blood pressure measurement which is less likely to represent the overall state of patients blood pressure. In a study conducted by Tucker et al, Missault LH et al, Erturk S et al and Mancia G et al stated that ideally, blood pressure must be measured in series/ ambulatory manner to see patients daily blood pressure on an average.[18],[19],[20],[21] Thus, these may add some bias to some extent. In studies conducted by Mancia G et al and Schmieder RE et al, other factors such as how long has an individual got hypertension i.e duration of Hypertension and mode of use of medication are shown to correlate positively with LVH. Their studies also showed that proper treatment may regress the LVH.[21],[22] In this study, among 21 patients with LVH, 85.7% had hypertension (n= 18), meanwhile among 29 others without LVH, 55.2% didn't have (n= 16). Interestingly, we found 3 patients with LVH who didn't even have hypertension (14.3%).

Table 6. Cross tabulation of hypertension and LVH

		LVH		
		Yes	**No**	**Total**
Hypertension	**Yes**	18	13	31
	No	3	16	19

Statistical analysis by using *Chi – Square* with CI (*Confidence Interval*) 95% showed that hypertension is significantly related to LVH (p = 0,003 < p = 0,05).

In our study we also found 13 patients with hypertension who didn't show LVH. It is note worthy that LVH itself is an adaptation which is dependent on multiple factors related to the state of the disease itself. In studies conducted by Drazner MH et al and Simone GD et al, it is stated that anti hypertensive agents, such as angiotension inhibitor and calcium channel blocker are able to lessen the degree of hypertrophy significantly, thus may prevent the incidence of LVH, regardless the degree of hypertension.[23],[24] Myocardium structure which is different from person to person also may explain above data. In a study conducted by Yamauchi et al, structure and the ability of myocardium to proliferate has been defined in the first year of life of newborn. Eventhough mechanical stress may trigger expression and activation of certain genes, such as *c-fos, c-myc, c-jun, dan Egr-1* to syhthesize additional myocyte, each individual will have limit in that process for some extent.[25]

Inversely, we found 3 patients with LVH who didn't show hypertension. As we mentioned earlier, none of the patients involved in this study had congenital heart diseases, but we noted that interestingly, all these 3 patients appeared to have history of coronary syndrome. Coronary syndrome which in turn results in hypoperfusion of myocardium will result in increased release of cytokines, including interleukin-6 which is shown to have ability to stimulate proliferation of cardiac muscle, thus resulting in hyperthrophy.[26] Yet, Further investigation is needed to explain this phenomenon.

It is also stated that increased level of circulating leptin also stimulate thickening of cardiac muscle as mentioned in a study conducted by Relatic et al.[26] In a study conducted by Avelar E et al for LVH in Severe obesity they found that higher levels of circulating leptin is an indication of excessive adipocytes accumulation which is shown in obese individual. Obesity itself is considered as "*volume overload*" state in which cardiac muscle has to work harder in order to keep perfusing the blood into high resistency area due to accumulation of lipid plaque and fat tissues.[27] In a study conducted by Hosseina SM et al involving obese children and adolescent with no previous history of CVD showed that obesity contributes to the incidence of LVH.[28]

CONCLUSION

In present study, we found that 85.7% of patients with hypertension develop LVH and that hypertension showed significant relationship to the incidence of LVH (p = 0.003 < p = 0.05). Further analysis with ANOVA showed that hypertension class has no significant correlation with the incidence of LVH p = 0.229 (p > 0.05), thus indicating that there is no proven consistency between hypertension class and LVH. This indicates that regardless the degree of hypertension, an individual may develop LVH, therefore, this issue must also be seriously addressed along with controlling blood pressure in the extent of hypertension management.

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