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Comparison of Left-Heart Structure in Patients with Valvular and Non Valvular Atrial Fibrillation at Haji Adam Malik Hospital Medan

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ABSTRACT

Background: Atrial fibrillation is still a most common arrhythmia. The incidence increases according to each remodeling of the heart chamber. Valvular and non valvular heart diseases have differences in hemodynamic adaptations that trigger a certain remodeling. However, until now it is not known whether there is a difference between the left heart structure and valvular and non valvular atrial fibrillation.

Method: There were 60 patients with atrial fibrillation hospitalized from August 2018 to December 2018. The samples were then divided into 2 groups, namely the valvular and non valvular groups, each with 30 samples. All samples that met the criteria underwent echocardiography. Then comparative statistics were carried out with p values <0.05 said to be statistically significant.

Results: In this study we found that coronary heart disease (CHD) was the most common etiology in the non valvular group (73.2%), whereas mitral stenosis was common in the non valvular group (67.7%). In this study there were no differences in left ventricular geometry in the two groups (p = 0.278). There were significant differences in left atrial diameter between the two groups (p = 0.0001). There were significant differences in pulmonary artery diameter between the two groups in this study (p = 0.0001).

Conclusion: There was no difference in the left ventricular geometry, but there were differences in the diameter of the left atrium and the diameter of the pulmonary artery.

INTISARI

Latar Belakang: Fibrilasi atrium masih merupakan aritmia yang sering ditemukan. Kejadiannya bertambah sesuai dengan setiap remodeling yang terjadi pada struktur jantung. Penyakit jantung valvular dan non valvular memiliki perbedaan hemodinamik yang memicu suatu remodeling. Namun hingga saat ini belum diketahui apakah terdapat perbedaan antara struktur jantung kiri dengan fibrilasi atrium valvular dan non valvular.

Metode : Didapati 60 pasien fibrilasi atrium yang dirawat inap sejak Agustus 2018 hingga Desember 2018. Sampel kemudian dibagi menjadi 2 kelompok, yaitu kelompok valvular dan non valvular, masing – masing 30 sampel. Semua sampel yang memenuhi kritera menjalani ekokardiografi. Kemudian dilakukan statistik komparasi dengan nilai p < 0.05 dikatakan bermakna secara statistik.

Hasil : Dalam penelitian in penyakit Jantung Koroner (PJK) didapati sebagai etiologi terbanyak pada kelompok non valvular (73.2%), sedangkan mitral stenosis menjadi etiologi terbanyak pada kelompok non valvular (67.7%). Pada penelitian ini tidak dijumpai adanya perbedaan geometri ventrikel kiri

pada kedua kelompok (p = 0.278). Didapati perbedaan diameter atrium kiri yang bermakna antara kedua kelompok di dalam penelitian ini, dengan nilai p = 0.0001. Didapati perbedaan diameter arteri pulmonalis yang bermakna antara kedua kelompok di dalam penelitian ini, dengan nilai p = 0.0001.

Kesimpulan : Tidak didapati ada perbedaan pada geometri ventrikel kiri, namun terdapat perbedaan pada diameter atrium kiri dan diameter arteri pulmonalis.

Introduction

Atrial fibrillation (AF) is the most commonly found arrhythmia in clinical practice. Between 1990 and 2013, although the global prevalence ratio has increased slightly, the overall number of AF cases is still increasing. Atrial fibrillation is the biggest burden on general health throughout the world, and prevalence increases in line with increasingly aging population, specifically in developing countries such as Brazil, India, China and Indonesia.[1]

The pathophysiology of AF is complex and not fully understood, but atrial remodeling and fibrosis play an important role. Hypertrophy and dilatation of the left ventricle cause an increase in end diastolic pressure, followed by left atrial enlargement. Hypertrophy and ventricular remodeling are important compensation processes that arise due to the response of the hemodynamic load and will cause an increase in ventricular pressure and affect the atrium and pulmonary vascularization. Remodeling will be more severe along with the duration of the disease.[2,3]

Epidemiologically, the presence of impaired left ventricular geometry is closely related to AF. Abnormal left ventricular (LV) mass is associated with a high prevalence of FA. But the background pathophysiology of the relationship is still unclear. Because in the process of heart disease, especially in ischemic heart disease hemodynamic, neurohormonal, and inflammatory pathways are the basic pathophysiology of both LV remodeling and FA, it is difficult to know whether these two things are separate cardiovascular maladaptive manifestations or there is a causal relationship between the two.[4]

Left ventricular remodeling is also related to the development of atrial fibrillation, but some etiologies of atrial fibrillation are based on different hemodynamic changes, for example in patients due to valvular and non valvular disorders. Comparison of changes in left heart geometry and pulmonary artery diameter between patients with atrial fibrillation due to valvular and non valvular etiologies is unknown. So the authors want to make a comparison between left heart structure and pulmonary artery diameter in patients with valvular and non valvular heart disease who have experienced atrial fibrillation.

Methods

Study Design and Population

This study is a cross-sectional study to analyze differences in left heart structure in valvular and non-valvular atrial fibrillation at the Heart Centre of Haji Adam Malik Hospital Medan in August 2018 to December 2018. Subjects were divided into 2 groups based on their etiology, which are valvular and nonvalvular groups. The total subjects included in this study were 60 people. Echocardiography was performed by residents in echocardiography division and was re-analyzed by echocardiography division supervisors.

Patients included in this study are hospitalized patients diagnosed with AF with valvular and nonvalvular etiology. The valvular etiologies are mitral and aortic structural diseases such as mitral stenosis, mitral regurgitation, aortic stenosis, and aortic regurgitation. And the nonvalvular etiologies are hypertensive heart disease and coronary artery disease. Patients with other supraventricular and ventricular arrhythmia and patients with electrolyte imbalance were excluded from this study.

Subjects hospitalized at Heart Centre of Haji Adam Malik Hospital Medan with atrial fibrillation will undergo echocardiography and those who meet the inclusion criteria are included in the study. The sample collected by consecutive sampling method and all subjects who met the inclusion and exclusion criteria were included as the study sample.

Baseline data includes subject identity, height and weight, disease history, treatment history, and diagnosis of underlying disease. Patients will then be divided into two groups according to the diagnosis of the underlying disease, namely the group with valvular heart disease and nonvalvular heart disease. Patients who meet the inclusion criteria will undergo an echocardiography examination.

When an echocardiography examination is conducted, informed consent is done. Echocardiography was carried out by residents of echocardiography division under the supervision of echocardiography supervisors.

Echocardiographic data will be taken from several views. From parasternal long axis view several parameters will be measured including left atrial diameter (mm), left ventricular diatolic dimension (LVEDD), left ventricular systolic (LVESD) dimension, diastolic interventricular septal thickness (IVSD), systolic interventricular septal thickness (IVSS), diastolic posterior left ventricular wall thickness (LVPWD), and posterior systolic left ventricular wall thickness (LVPWS). The results of these measurements will be included in the formula to obtain the left ventricular mass index (LVMI) and the relative

thickness of the left ventricular wall (RWT) to assess the geometry of the left ventricular structure.

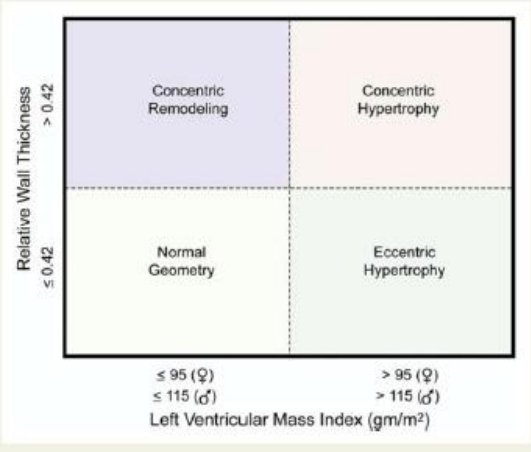

Figure 1. Classification of changes in ventricular geometry based on LVMI and RWT5

The diameter of the pulmonary artery is measured through the short axis view 1 cm below the pulmonary valve. Pumonal arterial pressure was measured with acceleration time in the right ventricular outflow pathway (ATRVOT) using pulsed wave doppler. Then calculated by the formula mPAP = 90 - (0.62 * ATRVOT). All the data will be collected and analyze with SPSS software program.

Data Analysis

The Kolmogorov-Smirnov and Saphiro-Wilk tests were used to determine the normality of data distribution. Data presentations for categorical variables were made in the form of percentage (%) while for numeric variables with normal distribution will be made in the form of mean ± standard deviation (SD), and in the form of mean ± standard error (SE) if the data was not normally distributed. Bivariate analysis was done using Student's t-test or Mann Whitney test for numerical variables, whereas in categorical variables using Chi-square or Fisher test. Analysis of statistical data using SPSS, p value <0.05 was said to be statistically significant.

RESULT

The study was conducted in the Department of Cardiology and Vascular Medicine Haji Adam Malik General Hospital Medan from August 2018 to December 2018 with a total sample of 60 atrial fibrillation patients which then divided into 30 samples in each group. Basic characteristics can be seen in the following table.

From Table 1 we see the number of male and female was equal, with male dominating in the non valvular group and female in the valvular group (p = 0.0001). It was found that the non valvular group had a larger body surface area of 68.8 + 10.96 (p = 0.0001). There was no significant difference in ventricular rate response in the two groups (p = 0.694). However, the systolic BP (p = 0.0001) and diastolic BP (p = 0.002) were found greater in the nonvalvular group.

Tabel 1.
Clinical Characteristics of Subjects by Group

Variable	Total n = 60	Valvular n = 30	Non valvular n = 30	P value
Male (N,%)	30 (50)	7 (23.3)	23 (76.7)	-
Age (Year)		41.33 + 14.23	58.07 + 9.79	0.0001
Weight (Kg)		52.43 + 7.2	68.87 + 10.96	0.0001
Height (cm)		157.37 + 6.61	165.37 + 8.36	0.0001
BSA (m2)		1.51 + 0.12	1.76 + 0.17	0.0001
Systolic BP (mmHg)		98.67 + 11.05	129.33 + 19.46	0.0001
Diastolic BP (mmHg)		69.3 + 17.2	82 + 12.2	0.002
HR (n,%)	60 (100)			0.694
SVR		2 (6.67)	1 (3.3)	
NVR		16 (53.3)	14 (46.7)	
RVR		12 (40)	15 (50)	
Antiarrhythmia (n,%)	60 (100)			0.0001
Digoxin		21 (70%)	0 (0)	
Beta blocker		9 (30%)	30 (100%)	
Amiodarone		0 (0)	0 (0)	

BSA = body surface area, BP = blood pressure, HR = heart rate, SVR = slow ventricular response, NVR = normal ventricular response, RVR = rapid ventricular response

In Table 2 it was found that the incidence of tricuspid valve regurgitation occurred more in the valvular group (28 people) with more severe severity (p = 0.017). It was also found that coronary artery disease (CAD) was the most common etiology in the non valvular group, while mitral stenosis (MS) was commonly found in the non valvular group. Most of the subjects in the valvular group have disorders related to one valve which were MS and mitral regurgitation (MR). Mitral regurgitation was found in both groups with significant differences in severity (p = 0.005). All samples with MS had a severe degree with a mean mitral valve area (MVA) of 0.5 + 0.38.

Table 2
Anatomical Characteristics of Subjects by Group

Variables	Total n = 60	Valvular n = 30	Non valvular n = 30	P value
Nonvalvular	30 (50)			-
Etiology		0(0)	8 (26.7)	
HHD		0(0)	22 (73.2)	
CAD				
Valvular Etiology	30 (50)			-
MS		11 (18.3)	0(0)	
MR		5 (8.3)	0(0)	
AS		0(0)	0(0)	
AR		0(0	0(0)	
MS MR		8 (13.3)	0(0)	
MR AR		3 (5)	0(0)	
AS AR		2 (3.3)	0(0)	
MS MR AS AR		1 (1.7)	0(0)	
TR (n,%)	52 (73.3)			0.017
Mild		4 (13.3)	12 (40)	
Moderate		14 (46.7)	6 (20)	
Severe		10 (33.3)	6 (20)	
MR (n,%)	44 (73.3)			0.005
Mild		4 (13.3)	6 (20)	
Moderate		4 (13.3)	14 (46.7)	
Severe		9 (30)	7 (23.3)	
AR (n,%)	8 (13.3)			0.052
Mild		1 (3.3)	2 (6.67)	
Moderate		5 (16.7)	0 (0)	
Severe		0 (0)	0 (0)	
TR Vmax		2.99 + 1.2	2.1 + 1.2	0.01
TR PG		41.7 + 26.6	25.3 + 17	0.006
MR Vmax		2.5 + 2.2	3.2 + 1.5	0.119
MR PG		44 + 44	51.4 + 35	0.479
MS (N,%)	20 (33.3)			0.0001
Mild		0 (0)	0 (0)	
Moderate		0 (0)		
Severe		20 (66.7)		
AS (N,%)	3 (5)			0.232
Mild		1 (3.3)	0 (0)	
Moderate		1 (3.3)		
Severe		1 (3.3)		
MVA		0.5 + 0.38	-	0.0001

HHD = hypertensive heart disease,
CAD = coronary artery disease,
MS = mitral stenosis,
MR = mitral regurgitation,
AS = aortic stenosis,
AR = aortic regurgitation,
TR = tricuspid regurgitation,
Vmax = maximal velocity,
PG = pressure gradient,
MVA = mitral valve area

In Table 3 the dilatation of the severe left atrium was only found in the valvular group, while in the nonvalvular group 16 people were classified as mild dilatation and 13 did not experience dilatation of the left atrium (p = 0.0001). There were no differences in the left ventricular mass index (LVMI) and relative wall thickness (RWT) in the two groups. Table 4 shows higher ejection fraction in valvular group (p = 0.0001).

Table 3.
Characteristics of Cardiac Structure Parameters Based o Echocardiography

Variables	Total n = 60	Valvular n = 30	Non valvular n = 30	P value
Mayor RA		62.9 + 15	51 + 8.9	0.001
Minor RA		40.3 + 12	39.7 + 6.5	0.823
Basal RV		44 + 8	42 + 8	0.537
LA dilatation (n,%)	44 (59.7)			0.0001
Mild		12 (40)	16 (53.3)	
Moderate		9 (30)	1 (3.3)	
Severe		6 (20)	0 (0)	
IVSD		9.5 + 2.7	10.5 + 3	0.219
IVSS		12.5 + 2.7	12.5 + 2.9	0.928
LVEDD		58 + 47.5	54.8 + 9.4	0.719
LVEDS		33.5 + 10	42.9 + 10.6	0.001
PWD		9.4 + 2.1	10.6 + 2.7	0.045
PWS		12.7 + 2.56	2.9 + 2.7	0.733
LVMI		121 + 73	132 + 48	0.477
RWT		0.42 + 0.12	0.40 + 0.14	0.787

Table 4.
Characteristics of Cardiac Function Based on Echocardiography

Variables	Total n = 60	Valvular n = 30	Non valvular n = 30	P value
TAPSE	60 (100)	17.9 + 5	19 + 6	0.438
EF (%)	60 (100)	58.6 + 10.3	40 + 15.3	0.0001

TAPSE = tricuspid annular plane systolic excursion,
EF = ejection fraction

In this study (Table 5) we found no differences in left ventricular geometry in either group. However, most of eccentric hypertrophy was found in the non valvular group. However, this was not significantly different, with a value of p = 0.278.

Table 5.
Comparison of Left Ventricular Geometry in Both Groups

LV geometry (N, %)	Atrial fibrillation		P VALUE
	Valvular n = 30	Non valvular N = 30	
Normal	7 (23.3)	5 (16.7)	0.278
Concentric Remodeling	9 (30)	4 (13.3)	
Eccentric Hypertrophy	9 (30)	15 (50)	
Concentric Hypertrophy	5 (16.7)	6 (20)	

There were significant differences in LA diameter between the two groups in this study, with a value of p = 0.0001. Where it appears that the valvular group has a greater diameter and as many as 20% of all valvular subjects are in the severe category. Whereas in the nonvalvular group most of the subjects were in the mild category and as many as 13 subjects did not experience dilated LA (Table 6).

Table 6
Comparison of Left Atrial Diameter in the Two Groups

Variables	Valvular N = 30	Non Valvular N = 30	P Value
LA diameter (mm)	52.10 + 11.53	40.83 + 6.77	0.0001
LA dilatation (N,%)			
Mild	12 (40)	16 (53.3)	0.0001
Moderate	9 (30)	1 (3.3)	
Severe	6 (20)	0 (0)	

There were significant differences in left atrial diameter between the two groups in this study (p = 0.0001). Where it appears that the valvular group has a greater pulmonary artery diameter value compared to the nonvalvular group. It is also shown that there are differences in pulmonary arterial pressure in both groups with a greater pressure found in the valvular group (Table 7).

Table 7
Comparison of Pulmonary Artery Diameter in Both Groups

Variables	Valvular N = 30	Non Valvular N = 30	P Value
Pulmonary Artery Diameter	2.4 + 0.21	1.66 + 0.21	0.0001
Pulmonary Artery Pressure	36.17 + 8.7	18 + 6.2	0.0001

Discussion

In this study we found in the valvular group, female subjects were dominating. This is in accordance with several studies that assess the prevalence of atrial fibrillation, where Sastry (2016) concluded that as many as 64% of patients are female and Singh (2017) presents 64.46% of female subjects.[6,7] While for the nonvalvular group, the majority of patients were male. This is in accordance with a study conducted by Renoux in 2011 that assessed the incidence in nonvalvular FA patients, of which 52.2% were male.[8]

In this study it was found that the valvular group had a smaller body surface area than nonvalvular. This is related to the risk factors for CAD associated with obesity, while valvular heart disease, especially mitral stenosis occurs more chronic, with prolonged inflammation, and right heart failure that is associated with gastrointestinal symptoms so that sufferers tend to experience cachexia.9 Mitral stenosis was found to be the most common etiology in the valvular group. This was also found in a study by Sastry (2016) which showed that mitral stenosis was the most common valvular lesion in the incidence of atrial fibrillation, which was 88.57%.[6]

In this study no differences in left ventricular geometry were found in either group. In the valvular group 16 people (53.3%) had normal geometry and concentric remodeling only. Concentric remodeling is said to still be a mild adaptation response that is reversible and may only be caused by age or exposure to risk factors for heart disease.10 This is probably due to the most common etiology in the valvular group is MS, so it rarely causes significant changes in the left ventricle. Whereas in the non valvular group, 70% experienced changes in concentric and eccentric hypertrophy which described the course of the disease involving the left ventricle.

In this study we hypothesized that valvular heart disease has a more severe change in left ventricular geometry, but in this study it appears that non-valvular disease has more severe changes in geometry. Although it has a more severe geometric change, the statistic test found no significant differences between the two groups. This is consistent with the research conducted by Aronow (1995) suggesting that an increase in left ventricular mass index in non-valvular patients increases the risk of atrial fibrillation (OR = 1.97).[11] Seko (2018) performed a study with logistic multivariate regression analysis that found left ventricular eccentric hypertrophy with hypertension was associated with atrial fibrillation (p = 0.0019). However, the sample in that study was greater than the sample in this study.2 In another study Seko in 2016 showed that the incidence of atrial fibrillation increased with the severity of changes in left ventricular geometry, ie the incidence of atrial fibrillation occurred 8.1% in normal geometry, 8.5% concentric remodeling, 11.3% in concentric hypertrophy, and 14.5% in eccentric hypertrophy.[12]

In one study it was suggested that the presence of ventricular hypertrophy and atrial fibrillation correlated very strongly. Abnormal left ventricular mass is associated with a high prevalence of atrial fibrillation, but the background of the pathophysiology of its association is not clearly known. Because hemodynamic, neurohormonal, and inflammatory pathways are linked to both of these, it is difficult to know whether ventricular hypertrophy and atrial fibrillation stand separately, or there is a causal relationship between the two.[13] From the results of this study it was answered that ventricular hypertrophy and atrial fibrillation were not interrelated and did not have differences in the two etiological groups.

This study found a significant difference in the diameter of the left atrium between the two groups, with a value of p = 0.0001. Where the valvular group has a diameter value greater than nonvalvular. And as many as 20% of all valvular subjects are in the category of severe dilation. Whereas in the nonvalvular group most subjects were in the mild category and 13 subjects did not experience dilatation of the left atrium. This is because in the valvular group, most patients have mitral stenosis, where significant left atrial stenosis occurs in mitral stenosis.[14] Whereas in the non valvular group there were patients who did not experience dilatation of the left atrium. In groups like this it is proven that atrial fibrillation is not always associated with atrial dilatation, but is related to the inflammatory process and fibrosis.[8] Probst (1973) made a study that compared the rhythm of sinus rhythm, paroxysmal FA, and permanent FA and related various degrees of enlargement of the left atrial diameter to answer whether left atrial enlargement was due to FA or caused FA. There was no difference in the results that

could demonstrate FA incidence in all three groups. Significant dilatation of the left atrium is only seen in the third group, which confirms that atrial dilatation is due to the FA. The longer the duration of the FA, the more severe the atrial dilatation.[15] Although in 2016 Yehia suggested that in patients with a non-valvular etiology an increase in left atrial diameter significantly increased the incidence of FA ($p = 0.043$).[16]

There was a significant difference in the pulmonary artery diameter of the two groups in this study, with a value of $p = 0.0001$. Where it appears that the valvular group has a greater pulmonary artery diameter value compared to the nonvalvular group. Likewise with pulmonary arterial pressure, which was found to be significantly different in the two groups ($p = 0.0001$), the pressure value was greater in the valvular group than nonvalvular. This is due to the fact that based on mitral stenosis hemodynamic which often causes pulmonary hypertension which causes widening of the pulmonary artery diameter compared to non valvular causes.[17] Approximately 83% of patients with pulmonary hypertension due to left heart disease occur in normal left ventricular function (good ejection fraction). And the conditions that cause it most are mitral valve disease.[18]

Until now it was unclear whether atrial fibrillation caused an increase in pressure and diameter of the pulmonary artery, or vice versa. Then whether the FA causes dilatation of the pulmonary arteries is also unknown. In a study by Rottlaender (2012), the presence of pulmonary hypertension was associated with an increased incidence of atrial fibrillation.[19] But in a study by Yousefian (2018) stated that in episodes of paroxysmal atrial fibrillation, pulmonary arterial pressure significantly increased compared with basic pulmonary artery pressure. Based on the results of the study it appears that in both etiologies, especially in the non valvular group, not all of them experience dilated pulmonary arteries and increased pulmonary artery pressure.[20] From the results of this study it is assumed that atrial fibrillation causes pulmonary hypertension and dilated pulmonary arteries.

Conclusion

Based on the results of data analysis obtained in this study, it can be concluded that there was no difference in left ventricular geometry in valvular and non valvular atrial fibrillation. But a significant difference was found in the left atrial diameter in the valvular and non valvular groups. Where non-valvular groups were found to have an average left atrial diameter greater than nonvalvular. And there were significant differences in pulmonary artery diameter and pressure in the valvular and non valvular groups. Where non-valvular groups were found to have a greater average than nonvalvular.

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