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Araştırma Makalesi / Research Article

Predictive Value of Left Atrial Volume Index and Right Ventricular Dilatation in Mitral Stenosis for Atrial Fibrillation

Mitral Stenozda Sol Atrial Volüm İndeksi ve Sağ Ventrikül Dilatasyonunun Atrial Fibrilasyon için Prediktif Değeri

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ABSTRACT

Purpose: To examine the predictive value of left atrial volume index (LAVI) and right ventricular dilatation in mitral stenosis (MS) for atrial fibrillation (AF) and to determine the cut-off value.

Materials and Methods: 14 men, 92 women, a total of 106 cases between the ages of 23-86 (mean: 50.7 ± 12.7) with mitral stenosis were included in the study. All echocardiographic assessments were performed according to the criteria of American Society of Echocardiography (ASE). Patients were divided into two groups as AF and normal sinus rhythm (NSR). 39 patients with AF were classified as AF group and 67 patients with normal sinus rhythm were classified as NSR group. The demographic, clinical, echocardiographic characteristics of these two groups were compared. For the statistical analysis of datas, Kolmogorov-Smirnov, T-test, Mann-Whitney-U test and ROC analysis were used.

Results: In mitral valve stenosis, left atrial volume index and right ventricular diastolic diameter increase. LAVI cut-off value for atrial fibrillation is 40,74 ml/m^2, the sensitivity and specificity of it was found to be as 80% and 80.6%, respectively (PPV = 69.0%, NPV = 88.5%). Cut-off value of right ventricular diastolic diameter (RVDD) for atrial fibrillation is 36.7 mm, the sensitivity and specificity of it was found to be as 62.9% and 59.7%, respectively (PPV = 46.0%, NPV = 75.5%).

Conclusion: It has been concluded that, there are cut-off values of LAVI and RVDD for the development of atrial fibrillation in mitral stenosis and to know those values that were important in determining treatment strategies.

Key Words: Atrial fibrillation, Left atrial volume index, Right ventricular dilatation, Mitral stenosis

ÖZET

Amaç: Mitral stenozda (MS) sol atrial volümindeksi (LAVİ) ve sağ ventrikül dilatasyonunun atrial fibrilasyon (AF) için prediktif değerini incelemek ve cutoff değerini belirlemektir.

Materyal ve Metod: Mitral darlığı olan ve yaşları 23-86 arasında (Ortalama: 50,7±12,7) 14 erkek, 89 kadın, toplam 103 olgu çalışmaya alındı. Ekokardiyografik değerlendirmeler Amerikan Ekokardiyografi Cemiyeti (ASE) kriterlerine gore yapıldı. Hastalar AF ve sinus ritmi (NSR) olmak üzere iki gruba ayrıldı.AF olan 36 hasta AF Grubu ve Sinüs ritminde olan 67 hasta NSR Grubu olarak sınıflandırıldı. Bu iki grubun klinik, demografik, ekokardiyografik özellikleri karşılaştırıldı.

Bulgular: Mitral kapak alanı azaldıkça sol atrial völüm indeksi ve sağ ventrikül diastolic çapı artmaktadır. Atrial fibrilasyon için LAVİ cut off değeri 40,74 ml/m2 olup sensitivitesi %80 ve spesifitesi %19.4 olarak bulundu. Atrial

fibrilasyon sağ ventrikül diastolic çapı (RVDÇ) için cut off değeri 36,7 mm olup sensitivitesi %62,9 ve spesifitesi %40,3 olarak bulundu.

Sonuç: Mitral stenozunda atrial fibrilasyon gelişimii çin LAVİ ve RVDÇ cut off değerlerinin olduğu ve bu değerleri bilmenin tedavi stratejilerini belirlemede önemli olduğu kanaatine varıldı.

AnahtarKelimeler: Atrial fibrilasyon, Sol atrial volüm indeksi, Sağ ventrikül dilatasyonu, Mitral stenozu

INTRODUCTION

Mitral stenosis is emerging as a result of rheumatic heart disease in less developed and developing countries and remains as a major health problem[1]. The atrial fibrillation developing in these patients causes an increase in stroke, heart failure and mortality[2,3]. It has been demostrated that, left atrial volume index had a predictive value for the development of atrial fibrillation[4]. In these patients, the predictive value of right ventricular dilatation and the cut-off value for atrial fibrillation are unknown. Our goal is to determine cut-off values of left atrial volume index, and right ventricular dilatation in mitral stenosis, which are important for the development of atrial fibrillation.

MATERIALS and METHODS

14 male and 92 female a total of 106 cases between the ages of 23-86 (mean: 50.7 ± 12.7) included in the study. The study was planned as a prospective study and approved by the ethics committee. Written informed consent document was obtained from the participants included in the study. The patients with known pulmonary disease, coronary artery disease and undergoing cardiac surgery were excluded from the study. The patients were divided into two groups as the patients with atrial fibrillation (AF group, n = 39) and normal sinus rhythm ones (NSR group, n = 67). Measurements were was performed using echocardiography device Vivid 7 (GE Healthcare), 2.5-5 MHz probes at rest, left side lying position. For all measurements, criterias specified by American Society of Echocardiography (American Society of Echocardiography, ASE) were used. Left atrial volume was measured by drawing the borders of the left atrium planimetrically, from standard apical 2 and 4 chamber at the end of systole. Left atrial volume was divided by the surface area of the body and so LAVI was obtained[5]. Mitral valve area was calculated planimetrically according to the pressure half time. Mitral stenosis was evaluated as valve area is less than 2 cm^2. Atrial fibrillation was diagnosed in accordance with the definitions guides of American College of Cardiology / American Heart Association and the European Society of Cardiology (ACC / AHA / ESC) by analyzing electrocardiographic recordings[6]. Right ventricular and left ventricular dimensions were measured with M-mode echocardiography.

Statistical analysis

Continuous variables are presented with mean ± SD and categorical variables are presented with frequency (%). Normality of continuous dataswere tested with Kolmogorov-Smirnov test. T-test analysis was used for difference analysis of continuous variables, Mann-Whitney-U test was used for difference analysis of categorical variables. For the cut-off values LAVI and AF, ROC curve analysis was used. Analysis was performed with SPSS 17.0 for Windows (SPSS Inc., Chicago, Illinois) the program.

RESULTS

Ninety-two (86.7%) patients with mitral stenosis were women, but in terms of atrial fibrillation, there was no significantly difference between the two groups in gender and mean age.Mean diastolic blood pressure and heart rate were significantly higher in AF group. The use of digitalis, diuretics, and anticoagulant therapy was higher in AF group ($p < 0.05$). Two groups had similar characteristics in terms of associated

valvular disease, diabetes, and body mass index (p> 0.05). (Table 1).

In AF group, mitral valve area was lesser, mitral E velocity, peak mitral diastolic pressure were higher. Left atrial diameter, volume, left atrial volume index, and right ventricular and right atrial diameter were higher (P <0.05). In terms of left ventricular systolic and diastolic diameters did not reach statistical significance, but LVEF was found to be significantly lower in AF group. (Table 2)

For the development of AF, cut-off values of LAVI and RVDD were 40.74 ml/m^2 and 36.7 mm, respectively, and sensitivity was found as 80% and 62.9%, specificity was found as 80.6% and 59.7%, respectively. (Figure 1).

Table 1: Patient Characteristics

Parameters	**AF Group (n:39)**	**NSR Group(n:67)**	**p**
Clinic and demographic parameters			
Age, (Mean+SD, years)	58.6±10.9	56.5±11.7	0,07
Male, n (%)	6(15.4)	8(16.7)	0.505
Female, n (%)	33(84.6)	59(83.3)	
Body mass index (kg/m^2)	30.3±5.4	28.7±5.9	0.181
Hypertension, n(%)	20(55.6)	35(52,2)	0.08
Systolic (mmHg)	121.4±17.0	118.1±16.9	0.347
Diastolik (mmHg)	77.3±12.2	70.0±11.0	0.03
Diabetes mellitus, n (%)	9(23,1)	8(11.9)	0.164
Heart rate (beat/min)	82.4±11.5	75.5±9.2	0.001
Aort valve disease, n(%)	5(13.9)	5(7.5)	0.294
Medical treatment			
Digoxin, n(%)	13(36.1)	2(3.0)	<0.05
Beta blocker, n(%)	17(47.2)	41(61.2)	0.175
Diuretic, n(%)	16 (44.4)	18(26.9)	0.07
Warfarin, n(%)	21 (53.4)	5 (7.5)	0.04

AF: Atrial fibrillation, NSR: Sinüs Rhythm.

Table 2: Patient Echocardiographic Parameters

Parameters	**AF Group(n=39)**	**SR Group (n=67)**	**p**
Echocardiogarphic Measurements			
Left atrial diameter (mm)	56.2±12.1	45.2±8.2	<0.05
Left atrial volume (ml)	153.9±106.5	81.3±33.0	<0.05
Left atrial volume index (ml/m2)	53.8±18.6	32.1±13.0	<0.05
Right atrial diameter (mm)	44.1±8.9	37.2±7.1	<0.05
Right ventricul diameter (mm)	38.9±5.4	35.5±5.1	0.003
sPAP (mmHg)	36.0±10.4	33.5±10.5	0.254
Mitral valv area, planimetric (cm2)	1.4±0.3	1.56±0.22	0.008
Mitral valv area, PHT (cm2)	1.34±0.3	1,55±0.24	0.001
Maximal mitral gradient (mmHg)	15.2±5.5	12.1±4.8	0.004
Mitral E velocity (cm/sn)	1.9±0.4	1.7±0.3	0.004
LVDD (mm)	47.5±7.2	47.1±6.2	0.788
LVSD (mm)	35.4±6.1	33.3±5.5	0.87
Posterior wall (mm)	10.1±4.4	9.0±1.2	0.059
Septal wall (mm)	10.2±6.4	8.6±1.4	0.072
Ejection Fraction (%)	57.6±6.2	61.5±6.9	0.006

AF: Atrial fibrillation, NSR: Sinüs Rhythm, LVDD: Left ventricular diastolic diameter, LVSD: Left ventricular systolicdiameter. sPAP: Systolic pulmonary artery pressure. PHT: Pressure half time.

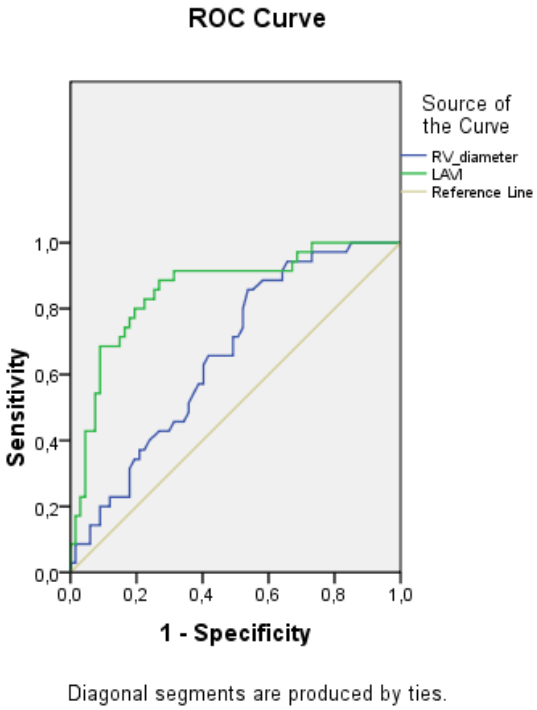

Figure1: ROC Analysis results for LAVI and RVDD.

DISCUSSION

The most common cause of AF is mitral valve disease. The incidence was reported as in general population, the elderly population and in mitral stenosis 0.15-1%, 4.8-17% and 40%[7,8,9]. Long-term elevation of left atrial pressure leads to left atrial dilatation, atrial fibrosis, and muscular atrophy. As a result of atrial remodeling occuring whose mechanism was poorly understood, the ectopic activities going out from pulmonary veins or other regions may lead to atrial fibrillation[10,11]. In the formation of atrial fibrillation, left atrial remodeling and right atrial and right ventricular remodeling were effective. Right ventricular dilatation by causing right atrial remodeling, prepares the ground for formation of atrial arrhythmias. Severe mitral stenosis leads to pulmonary hypertension, right ventricular failure and atrial remodeling. This situation is more evident in cases where mitral valve area was <1 cm^2 and pulmonary vascular resistance was > 5 wood unit[12,13,14]. In Framingham study, it has been reported that, the incidence of atrial fibrillation in right ventricular dilatation increased two-fold[15].

Studies are demostrated that, the right ventricle and the right atrium dilatation were more obvious in patients with mitral stenosis and atrial fibrillation[16,17]. In these studies and in the literature, we did not find any study which reported that the cut off value of the diameter of the right ventricle for atrial fibrillation. In our study, the cut off value of the diameter of the right ventricle for atrial fibrillation was 36.7 mm and sensitivity and

specificity were calculated as 59.7%, 62.9% respectively.

Mechanical obstruction occuring in mitral stenosis leads to the increase in left atrial volume, left atrial dilatation and atrial remodeling. LAVI is as well as an important marker in the development of atrial fibrillation and seems to be an important parameter in predicting atrial fibrillation. The importance of LAVI, it has been used in atrial fibrillation, for monitoring of the success of electrical cardioversion and the formation of and recurrence, the results of mitral balloon valvuloplasty, and prognosis of acute myocardial infarction and development of major cardiac event, and to predict AF recurrences after radiofrequency ablation and it has been shown that, increased LAVI values were associated with poor prognosis[6,18,19,20]. However, in these studies, the cut off value of LAVI for AF has not been reported. ASE was reported for LAVI as '' heavy increased value '' as ≥ 40 ml/m^2[25]. In our study, the cut off value for atrial fibrillation that we found (Cut-off value: 40.74 ml/m^2) was very similar to this value. In our literature review, we did not find clear cut-off value for LAVI for atrial fibrillation in mitral stenosis.

The duration of mitral stenosis is preparing ground for the formation of atrial fibrillation. Left atrial pressure increase caused by long-term mechanical obstruction is preparing ground for the development of atrial fibrillation[10,11,20]. In parallel to these findings in our study, we determined that the average age of patients with AF was more.

Study limitations

The start time of atrial fibrillation was not known, AF was not classified as paroxysmal, permanent or persistent, AF was not investigated by holter and these parameters were not certain when it started. And there are the limitations of the study. In addition, the other clinical parameters which are effective in the development of AF were excluded from the study and electrophysiological study was not performed. And these are also evaluated as limitations.

CONCLUSION

Atrial fibrillation may occur as a result of increase of left atrial volume, right ventricular dilatation and left-right atrial remodeling. With the development of AF, the clinical presentation worsens and prognosis was affected. In mitral stenosis, LAVI and right ventricular dilatation are the parameters which have predictive and cut-off values for the development of atrial fibrillation. In this study, it has been revealed that, other echocardiographic parameters should be determined in addition to the cut-off values which we have put forth for atrial fibrillation.

Conflict of interest:none declared

REFERENCES

1. Carabello BA. Modern Management of Mitral Stenosis. Circulation. 2005;112:432-7
2. Barnes ME,Miyasaka Y,Seward JB,et al. Left atrial volume in the prediction of first ischemic stroke in an elderly cohort without atrial fibrillation. Mayo Clin Proc. 2004;79:1008-14
3. Ristow B, Ali S, Whooley MA, Schiller NB. Usefulness of Left Atrial Volume Index to Predict Heart Failure Hospitalization and Mortality in Ambulatory Patients With Coronary Heart Disease and Comparison to Left Ventricular Ejection Fraction (from the Heart and Soul Study). Am J Cardiol. 2008;102:70-6
4. Tsang TS,Barnes ME,Bailey KR,et al. Left atrial volume: important risk marker of incident atrial fibrillation in 1655 older men and women. Mayo Clin Proc. 2001;76:467-75.
5. Lang RM,Bierig M,Devereux RB,et al. Chamber Quantification Writing Group; American Society of Echocardiography's Guidelines and Standards Committee; European Association of Echocardiography. Recommendations for chamber quantification: a report from the American Society of Echocardiography's Guidelines and Standards Committee and the Chamber Quantification Writing Group, developed in conjunction with the European Association of Echocardiography, a branch of the

European Society of Cardiology. J Am SocEchocardiogr. 2005;18:1440-63.

6. Fuster V, Rydén LE, Cannom DS, et al. ACC/AHA/ESC 2006 Guidelines for the Management of Patients With Atrial Fibrillation: A Report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines and the European Society of Cardiology Committee for Practice Guidelines (Writing Committee to Revise the 2001 Guidelines for the Management of Patients With Atrial Fibrillation) Developed in Collaboration With the European Heart Rhythm Association and the Heart Rhythm Society. Circulation. 2006;114:257-354
7. Wood P. An appreciation of mitral stenosis. Brit Med J. 1954;1:1113-24.
8. Furberg CD, Psaty BM, Manolio TA, et al. Prevalence of atrial fibrillation in elderly subjects (The Cardiovascular Health Study). Am J Cardiol. 1994;74:236-41.
9. Savage DD,Garrison RJ,Castelli WP,et al. Prevalence of submitral (annular) calcium and its correlates in a general population-based sample (The Framingham Study). Am J Cardiol. 1983;51:1375-8.
10. Schotten U, Verheule S, Kirchhof P, Goette A. Pathophysiological mechanisms of atrial fibrillation: a translational appraisal. Physiol Rev. 2011;91:265-325
11. Selzer A, Cohn KE. Natural history of mitral stenosis: a review. Circulation. 1972;45:878-90
12. Moreyra AE,Wilson AC,Deac R,et al. Factors associated with atrial fibrillation in patients with mitral stenosis: a cardiac catheterization study. Am Heart J 1998;135:138-45
13. Lewis BM, Gorlin R, Houssay HE, et al. Clinical and physiological correlations in patients with mitral stenosis. Am Heart J. 1952;43
14. Ward C, Hancock BW. Extreme pulmonary hypertension caused by mitral valve disease. Natural history and results of surgery. Br Heart J. 1975;37:74-8
15. Vaziri M, Larson MG, Benjamin EJ, Levy D. Echocardiographic predictors of nonrheumatic atrial fibrillation. The Framingham Study. Circulation. 1994;89:724-30
16. Arisoy E, Korkmaz İ, Eren ŞH, et al. Analyses of the Risc Factors for Atrial Fibrillation Among the Patients Who were Admitted to Emergency Service. J Clin Anal Med. 2012;3:143-6
17. Arslan Ş, Büyükkaya Ş, Gündoğdu F, et al. Romatizmal mitral darlığı olan, sinus ritimli veya atriyal fibrilasyonlu hastalarda sağ ventrikül fonksiyonlarının doku Doppler eko kardiyografi ile değerlendirilmesi. Arch Turk Soc Cardiol. 2007;35:475-81
18. Akdemir B,Altekin RE,Küçük M,et al. The significance of the left atrial volume index in cardioversion success and its relationship with recurrence in patients with non-valvular atrial fibrillation subjected to electrical cardioversion: a study on diagnostic accuracy. Anadolu Kardiyol Derg. 2013;13:18-25.
19. Nair A, Fischer A. Atrial fibrillation in hypertrophic cardiomyopathy: mechanisms, embolic risk and prognosis. Anadolu Kardiyol Derg. 2006;6:40-3
20. Sakaguchi E, Yamada A, Sugimoto K, Ito Y, Shiino K, Takada K, Iwase M, Ozaki Y. Prognostic value of left atrial volume index in patients with first acute myocardial infarction. Eur J Echocardiogr. 2011;12:440-4.

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