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INTERRELATIONSHIP BETWEEN RHYTHM, LEFT ATRIAL SIZE AND THROMBUS FORMATION IN PATIENTS WITH MITRAL STENOSIS

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Contribution
All the authors contributed significantly to the research that resulted in the submitted manuscript.

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ABSTRACT

Objectives: To study the Interrelationship between rhythm, left atrial size and thrombus formation in patients with mitral stenosis.

Methodology: This observational study was conducted in cardiology department LRH Peshawar, from February to December 2011. Every patient with severe mitral stenosis presenting for PTMC was evaluated before procedure for spontaneous echo-contrast, left atrial size, LA/LAA thrombus and its types on TTE and TEE. Baseline ECG of each patient was taken.

Results: A total of 176 patients with mitral stenosis were divided into 110 patients in group I having sinus rhythm and 66 patients in group II having atrial fibrillation. In group I, 40 (36.36%) were males compare to group II having 14 (21.21%). Mean age of patient in group I was 33.13 years ± 13.82 as compared to 30.97± 8.86 years in group II. In group I, 29 (26.36%) had LA/LAA thrombus as compared to 32(48.48%) in group II on TEE(p-value=0.003). In group I, 60(54.54%) patients had spontaneous echo contrast as compared to 58(87.87%) in group II on TEE (p-value=0.000). Mean left atrial size in group I was 4.2±0.52cm as compared to 5.3±0.71cm in group II (p-value=0.000). In patients with AF, LA/LAA thrombus was visualized in 10 (15.15%) on TTE as compared to 32(48.48%) on TEE(p value=0.001).

Conclusion: Atrial fibrillation is frequently associated with left atrial enlargement and thrombus formation in patients with mitral stenosis. The accessibility of the left atrial appendage by TEE is better than TTE in detection of thrombi.

Key Words: Atrial thrombus, transthoracic echocardiography(TTE), Transesophageal echocardiography(TEE), percutaneous transluminal mitral commissurotomy(PTMC).

INTRODUCTION

Mitral stenosis is a huge burden in third world countries because of increased prevalence of rheumatic heart disease. One of the study shows that the incidence of rheumatic fever is 206/100,000 and prevalence of rheumatic heart disease is 18.6/1000.[1] The prevalence of RHD in Pakistan is also high like other third world countries and was found to be 22/1000 in inner Lahore and 5.7/1000 in rural Pakistan in recent studies.[1]

The most frequently affected valve in rheumatic heart diseases is mitral valve (MV).[2] It is solely affected in 25% and is affected in combination with other valves in 40% of patients.[2]

Mitral stenosis can lead to enlargement of the LA leading to increased risk of thrombus formation.[3] The frequency of left atrial thrombi is 20-33% in different studies.[4,5,6] Left atrial thrombus is more frequently associated with embolic events.[6]In patients with rheumatic heart disease 50 % of left atrial thrombi, and in patients with non-valvular AF nearly 90% of LA thrombi are limited to the LA appendage.[6] The factors influencing the left atrial thrombi in rheumatic heart diseases includes LA size, atrial fibrillation, severity of mitral stenosis ,increasing age and spontaneous echo contrast.[7] The thromboembolic events is more frequently encountered in mitral stenosis patients having atrial fibrillation than in sinus rhythm.[7,8] Echocardiography has become the key tool for the diagnosis and evaluation of valve disease, and is the primary non-invasive imaging method for valve stenosis assessment. The accessibility of the left atrial appendage by TEE is better than TTE in detection of thrombi.[9] The sensitivity and specificity of TEE for left atrium and the left atrial appendage thrombi are reported to be 100% and 99%,respectively.[10] Ahmad et al have reported that AF and LA dilatation are frequent associations of LA thrombus.[11] Left atrial enlargement is frequently seen in patients with AF, having mitral valve disease, annular calcification, hypertension and left ventricular dilation.[12] persistent AF itself can lead to further increase in left atrial size [13], which is reversible with cardioversion and maintenance of sinus rhythm [14].

Spontaneous echo contrast is the presence of dynamic, smoke-like echoes seen during performing TEE, most frequently in mitral stenosis patients. Spontaneous echo contrast is seen in about 50% of atrial fibrillation patients and in more than 80 percent of those with AF and left or right atrial appendage thrombi.[15,16] This phenomenon represents erythrocyte aggregation in low shear rate conditions.[17] The left atrial spontaneous echo contrast is frequently seen in mitral stenosis patients and nonvalular AF. [18,19] Mitral regurgitation (MR) in conjunction with MS reduces the risk of left atrial thrombus formation.[4,20] Due to these serious implications of LA thrombus, it is mandatory to search for the LA clot in patients of MS especially if there is concomitant AF.[21]Once a thrombus is detected in LA the treatment plan, strategies, surgical and interventional techniques are greatly altered.[22]

METHODOLOGY

This observational study was conducted in Department of Cardiology PGMI, LRH, Peshawar, from 01 February 2011 to 31 December 2011. The frequency of left atrial thrombus in patients of mitral stenosis with atrial fibrillation and sinus rhythm is 33% and 13.5% respectively.[4,5,24] Using casagrande, pike & smith sample size calculator, the total sample size was 151 having 43 patients with atrial fibrillation, but sample size was enlarged to 176 with 66 atrial fibrillation patients. The Sampling technique was Non probability consecutive sampling**.** Every patient with severe mitral stenosis presented to cardiology unit LRH Peshawar for percutaneous transluminal mitral commissurotomy (PTMC) was evaluated first with TTE and then with TEE before undergoing PTMC for left atrial diameter , visualization of left atrial (LA) and left atrial appendage(LAA) thrombus and spontaneous echo contrast. Base line ECG of each patient was taken. Informed and written consent was obtained from each patient. All the data was collected on pre-designed proforma. Patients with significant aortic valve disease, mitral regurgitation, previous PTMC, closed mitral valvotomy (CMV) and patients taking antiplatelet or anticoagulation therapy were excluded from study. In order to control the bias in the study TTE and TEE was performed by same machine and same operators.

LA thrombus was diagnosed by the presence of well defined echogenic intracavity mass with an echotexture different from that of underlying endocardium and not due to pectinate muscle.

LA thrombus based on their location, extension, and mobility as assessed by TTE/TEE were classi ed as follows:

Type Ia: LA appendage clot con ned to appendage.

Type Ib: LA appendage clot protruding into LA cavity.

Type IIa: LA roof clot limited to a plane above the plane of fossa ovalis.

Type IIb: LA roof clot extending below the plane of fossa ovalis.

Type III: Layered clot over the interatrial septum (IAS).

Type IV: Mobile clot which is attached to LA free wall or roof or IAS.

Type V: Ball valve thrombus (Free Floating).

LA spontaneous echo contrast was diagnosed by the presence of dynamic smoke like echoes in the LA cavity and LA appendage with swirling motion distinct from white noise artifact after adjusting the gain setting properly.

Severe mitral stenosis was defined by echocardiograpic criteria as associated with mean transvalular gradient of more than 10 mm of Hg, pulmonary artery pressures of more than 50 mm of Hg and a valve area of less than 1 cm^2.

Transthoracic echocardiography was performed by a standard technique using Toshiba Xario 2100 and Philips D H 11echocardiographic machines. M-mode measurements were recorded according to American Society of Echocardiography criteria.[23] The mitral valve area was measured by continuous wave Doppler using the pressure half time method. The mean transmitral diastolic pressure was estimated from the maximal transmitral flow velocity using a modified Bernoulli equation. LA diameter was taken in the parasternal long axis view in M-mode at end systole. Measurements were taken in three beats in patients with normal sinus rhythm and in ten beats in atrial fibrillation and the mean values were taken for analysis.

TEE was performed after TTE in all cases. A 5-MHz transducer multiplane probe was used. All patients were given local pharyngeal anesthesia (1% lidocaine spray) and intravenous midazolam. During the study pulse rate, blood pressure, pulse oximetry and single lead ECG were monitored. TEE probe was introduced with the patient lying supine in left lateral position. The LA was scanned in short axis view and bicaval view. With a counterclockwise rotation of the probe at the level of aortic valve, the LA appendage was visualized. After completion of TEE, patients were observed for 3 hours in ward prior to discharge.

All the data were analyzed by SPSS (Statistical Package for Social Sciences) Version 19.0 for Windows. Categorical variables were expressed as numbers and percentages while continuous variables were expressed as mean ± SD (Standard deviations). 5% level of significance was used. For comparing numerical variables student T test was used and for comparing categorical variables chi-square test was used.

RESULTS

We studied 176 consecutive patients of severe mitral stenosis presented to cardiology unit for percutaeous traansluminal commissurotomy, which were divided into two groups, group I were the patients in normal sinus rhythm and group II were the patients with atrial fibrillations. Group I have total of 110 out of total 176 patients while group II have 66 patients. Patients in both groups were then studied for gender distribution, age, left atrial /left atrial appendage (LA/LAA) thrombus ,spontaneous echo contrast and left atrial size. In group I with total patients of 110 in sinus rhtym, 40 (36.36%) were males and 70(63.63%) were females. In group II out of total 66 patients with atrial fibrillation 14 (21.21%) were male and 52(78.78%) w were females. The mean age of patient in group I was 33.13±13.82 years as compare to 30.97±8.86 years in group II (p-value = 0.258). In group I, spontaneous echo contrast was seen in 60(54.54%) as compared to 58(87.87%) in group II on TEE, which was statistically significant (p value=0.00%). On TTE spontaneous echo contrast was seen in 46 (41.82%) patients of group I while in 43(65.15%) patients of group II(p value=0.008).The mean left atrial size in group I was 4.2 ± 0.52 cm as compare to 5.3± 0.71 cm in group II,

Table 1: Baseline and echocardiograpic characteristics in patients with normal sinus rhythm and atrial fibrillation with underlying mitral stenosis

Characteristics	Total (n=176)	Group I (n=110) Sinus rhythm	Group II(n=66) Atrial fibrillation	p- value
Age(years)	32.32±12.21	33.1±13.82 years	30.97±8.86 years	0.258
Male	54(30.7 %)	40(36.36%)	14(21.21%)	0.043
Female	122(69.3%)	70(63.63%)	52(78.78%)	0.043
Left atrial size(cm) on TTE	4.68±81	4.2±52	5.3±71	0.000
Spontaneous echo contrast(SEC) on TEE	118(67%)	60(54.54%)	58(87.87%)	0.000
Spontaneous echo contrast(SEC) on TTE	89(50.56%)	46(41.82%)	43(65.15%)	0.008
Left atrial/left atrial appendage thrombus on TEE	61(34.7%)	29(26.36%)	32(48.48%)	0.003
Left atrial/left atrial appendage thrombus on TTE	18(10.23%)	8(7.27%)	10(15.15%)	0.002

Table 2: LA/LAA thrombus types seen on TTE and TEE in normal sinus rhythm

LA/LAA Thrombus types	TTE 8(7.27%)	TEE 29(26.36%)	p-value (0.002)
Type Ia	1(0.9%)	16(14.5%)	
Typelb	1(0.9%)	5(4.5%)	
Type IIa	1(0.9%)	3(2.7%)	
Type IIb	2(1.8%)	2(1.8%)	
Type III	2(1.8%)	2(1.8%)	
Type IV	1(0.9%)	1(0.9%)	
Type V	0(0.0%)	0(0.0%)	

Table 3: LA/LAA thrombus types seen on TTE and TEE in Atrial fibrillation

LA/LAA Thrombus types	TTE 10(15.15%)	TEE 32(48.48%)	p-value 0.001
Type Ia	3(4.5%)	19(28.8%)	
Typelb	1(1.5%)	5(7.5%)	
TypeIIa	1(1.5%)	3(4.6%)	
TypeIIb	2(3%)	2(3%)	
TypeIII	2(3%)	2(3%)	
Type IV	1(1.5%)	1(1.5%)	
Type V	0(0.0%)	0(0.0%)	

which was statistically significant(p-valve = 0.00). These results are shown in table I. In group I, LA/LAA thrombus was visualized in 8 (7.27%) on TTE as compared to 29(26.36%) on TEE (p value = 0.002). In group II, LA/LAA thrombus was visualized in 10 (15.15%) on TTE as compared to 32(48.48%) on TEE (p value = 0.001). These results are summarized in table II & III.

DISCUSSION

Mitral stenosis can lead to enlargement of the LA leading to increased risk of thrombus formation.[3] Mitral stenosis is more commonly associated with thrombus formation in the LA than mitral regurgitation; furthermore the increasing severity of mitral stenosis is significantly correlated with increased incidence of thrombus in the LA and LA appendage.[23] TEE is superior to TTE in the evaluation of LA thrombi[6]. In the present study we evaluated 176 patients of severe mitral stenosis. Our patient population was younger. Mean age was found to be 32.32±12.21 years ,and majority of them were female i.e. 69.3%. The majority were in sinus rhythm i.e. 62.5% while rest were in atrial fibrillation. The frequency of LA thrombus was 34.7 % in our study in total, more frequent in atrial fibrillation group than in sinus rhythm group . These finding are supported by many other studies.[4-8] In various earlier studies, the frequency ranged from 26-33%.[4,5] In our study the left thrombi frequency is about the same as most other studies. We used TEE in our study for visualization of left atrium and left atrial appendage as its role is well established in many studies.[6] Goswami et al [4] studied 200 consecutive patients of severe mitral stenosis. In their study patients with AF had higher incidence of thrombus as compared to the patients with sinus rhythm. This study supports our finding as we also observed occurrence of LA thrombus more frequently in patients with AF than sinus rhythm. Saidi et al [24] studied 203 patients of mitral stenosis who presented for PTMC or mitral valve surgery. 52.7% had normal sinus rhythm while 47.3% had AF. In ist group, 13.5% patients had LA thrombus as compared to 26.1% in second group; the difference was statistically significant. In our study patients in AF group were also having more LA/LAA

thrombus than sinus rhythm group and were statistically significant. In our study we have more frequent echo contrast than Ahmad et al.[11] This is most probably because of large sample size. Srimannarayana et al [5] in their study of 490 patients undergoing TEE noted that LA thrombi were present in 163 (33.2%), supporting our study findings i.e. 34.7%. In a small group of 50 patients with mitral stenosis and AF, Hwang et al[25] observed an LA thrombus in 28 patients (56%) by TEE. Karatasakis et al[26] observed an LA thrombus in 12 patients (54%) in a total of 22 studied patients with AF and mitral stenosis. In our study the prevalence of LA/LAA thrombus in AF group with severe mitral stenosis was about 48.48 %, nearly similar to Karatasakis et al[26] observation.

In a study from China, the left atrial clots were more frequently present in MS with small valve area, high valve gradients and no MR, but did not reveal any relation to left atrial size.[20] In other reports, however, left atrial size and age were shown to be related to the presence of a clot.[7, 20, 28] Other studies have also revealed the significant effect of AF on left atrial clot formation.[4, 27-29] The left atrial spontaneous echo contrast is frequently seen in mitral stenosis patients and nonvalular AF, [18, 19] supporting our study. Despite the fact that left atrial clot is usually found in MS with AF, severe mitral stenosis patients in sinus rhythm are also at risk of intra-atrial clot formation. Although this risk is less than the AF group, but it is sufficient enough to warrant measures for prevention of thromboembolic events, thus every patient planning for percutaneous transluminal mitral valve commisurotomy should undergo transesophageal echocardiography before the procedure to prevent thromboembolic events.

CONCLUSION

Atrial fibrillation is frequently associated with left atrial enlargement and thrombus formation in patients with mitral stenosis. The accessibility of the left atrial appendage by TEE is better than TTE in detection of thrombi.

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