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Left Atrial Appendage Morphology, Does it Matter?

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Abstract

Background: Left atrial appendage is the commonest site of clot formation in patients with mitral stenosis. Left atrial appendage has different shapes in different patients. Does this morphological variation predispose to clot formation? needs to be studied.

Material and methods: Transesophageal echo was performed. Left atrial appendage's width and depth was noted in midesophageal position, short axis view. Presence or absence of clot in LAA and patient's rhythm was noted.

Results: Sixty four patients having mitral stenosis underwent transesophageal echo 8 (12.5%) patients had LAA more wide than deep, 4 (6.25%) patients had width and depth of LAA equal, 52 (81.25%) patients had depth of LAA greater than width. 20 (31.25%) patients were having clot in LAA. Eight (40%) of them were in atrial fibrillation while 12 patients (60%) were in sinus rhythm. Four patients who had clot in LAA, had LAA more wide than deep, one of them was in atrial fibrillation, while remaining three were in sinus rhythm. In 15 patients LAA was more deep than wide, 7 were in atrial fibrillation and 8 were in sinus rhythm. One patient had clot in LAA who had width and depth equal and that was in sinus rhythm. Out of 11 patients in atrial fibrillation 8 (72.7%) had clot in LA appendage and out of 53 patients in sinus rhythm 12 (22.64%) were having clot.

Conclusion: LAA is deep or shallow, it does not predispose to clot formation when in sinus rhythm but if the patient is in atrial fibrillation the deeper LAA with narrow opening into LA has more chances of clot formation.

Keywords: Left atrial appendage; Clot formation; Depth and width of LAA

Introduction

Stroke is a disabling condition and every effort must be made to find out its causes and treat them to save one's life from this ailment. Thromboembolism is a major cause of stroke especially in patients of mitral stenosis. Approximately 90% of thrombi in the left atrium are formed in the left atrial appendage [1].

Left atrial appendage morphology is an important determinant of clot formation. There are four different shapes of LAA, Chicken wing, cactus, cauliflower and windsock. It is known that chicken wing morphology is less likely to have stroke. Cactus morphology has 4 times increased risk, windsock morphology 5 times increased risk and cauliflower shape 8 times increased risk of stroke or TIA [2].

LA appendage outflow velocity is another determinant for clot formation. LA appendage outflow velocity more than 40 cm/s is normal. The velocity less than 20 cm/s is associated with sluggish flow and clot formation [3].

Atrial fibrillation, valvular as well as nonvalvular is associated with clot formation in left atrium. Therapeutically Left atrial appendage is made isolated from left atrium so that clot once formed in LA appendage must not be embolized. Left atrial appendage closure by WATCHMAN device by percutaneous technique has recently proved its safety and efficacy [4].

Which LA appendage must be closed is not studied yet. We first must know that what type of LA appendage morphology predisposes to clot formation. On TEE images, whether deeper LA appendage with narrow opening into left atrium or shallow LA appendage with wide opening into LA is associated with clot formation? Needs to be studied and we planned to do that in our study.

Material and Methods

This cross sectional observational study was conducted at Punjab Institute of cardiology between February 2015 to November 2016. Patients admitted for percutaneous transvenous mitral commissurotomy (PTMC) already consented for transesophageal echo (TEE) were studied. All TEE tests were performed on GE vingmed Vivid 7 machine using 6T probe. Left atrial appendage (LAA) morphology was noted in midesophageal short axis view between 25° to 45° angle where best LAA view was obtained. Depth and width as shown in Figures 1A and 1B were noted. Ratio of width to depth was calculated. Presence or absence of clot in LAA was also noted. Patients' heart rhythm whether atrial fibrillation or sinus rhythm was also recorded. Patients included were belonging to both sexes and of any age. Patients on warfarin, INR ≥ 1.5, presence of clot other than LAA were excluded from the study.

Statistical Analysis

Data was analyzed by using SPSS version 22.0. Qualitative variables were express as frequency, percentage. Quantitative variables were expressed as mean ± SD. Fisher exact test was applied to test the association of the LAA morphology with clot in the presence or absence of AF. P-value ≤ 0.05 was considered as significant. All test applied as two tails.

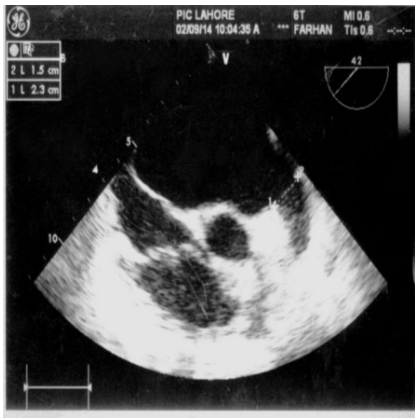

Figure 1A: TEE image showing LAA.

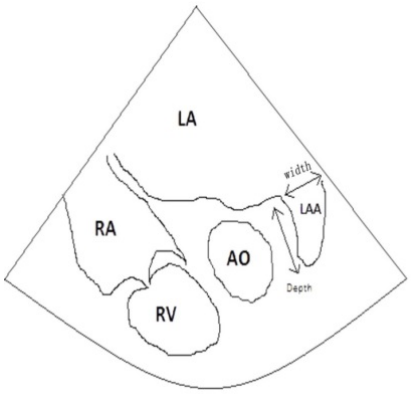

Figure 1B: Handmade image of LAA showing its width and depth measurements.

Results

Sixty four patients having mitral stenosis admitted for percutaneous transvenous mitral commissurotomy, underwent transesophageal echo. 49 (76.6%) patients were female and 15 (23.4%) were male patients. The patients' age ranged from 16-53 years (mean age 31.83 ± 8.49 years). Clot was present in twenty (31.25%) patients (Table 1). LAA width was 22.5 ± 4.77 mm (12-39 mm), depth was 26.68 ± 5.59 mm (16-44 mm) and ratio was 0.86 ± 0.186 (0.55-1.44). Eleven patients (17.2%) were in atrial fibrillation while 53 patients were in sinus rhythm.

Eight (12.5%) patients had LAA more wide than deep, 4 (6.25%) patients had width and depth of LAA equal, 52 (81.25%) patients had depth of LAA greater than width. 20 (31.25%) patients were having clot in LAA. Eight (40%) of them were in atrial fibrillation while twelve patients (60%) were in sinus rhythm. Four patients who had clot in LAA had LAA more wide than deep one was in atrial fibrillation and 3 were in sinus rhythm. In 15 patients LAA was more deep than wide, 7 were in Atrial fibrillation and 8 were in sinus rhythm (p value 0.003). One patient had clot in LAA who had width and depth equal and that was in sinus rhythm (Table 2).

When we compared the patients having presence or absence of clot, it was seen that atrial fibrillation was the most important determinant of clot formation. Out of 11 patients in atrial fibrillation 8 (72.7%) had clot in LA appendage and out of 53 patients in sinus rhythm 12 (22.64%) were having clot (p value 0.001). Six of the male patients and 14 of the female patients were having clot in left atrial appendage (LAA) (Table 3). Age of the patients was comparable in both the groups, similarly width and depth of LAA was similar in both groups.

Gender	Male	15 (23.4%)
	Female	49 (76.6%)
Clot	Absent	44 (68.75%)
	Present	20 (31.25%)
Age		31.83 ± 8.49 (Range: 16-53)
Width (mm)		22.50 ± 4.778 (Range: 12-39)
Depth (mm)		26.68 ± 5.59 (Range: 16-44)
Ratio		0.86 ± 0.186 (Range: 0.55-1.44)
RHYTHM	Atrial fibrillation	11 (17.2%)
	Sinus rhythm	53 (82.8%)

Table 1: Baseline demographic variables.

LAA morphology	Rhythm	Clot present (n=20)	Clot absent (n=44)	Total (n=64)	P value
Width>depth	Atrial fibrillation	1	1	2	1
	Sinus rhythm	3	3	6	
Width<depth	Atrial fibrillation	7	1	8	0.003
	Sinus rhythm	8	36	44	
Width=depth	Atrial fibrillation	0	1	1	1
	Sinus rhythm	1	2	3	

Table 2: Presence or absence of clot with respect to rhythm and LAA morphology.

Variables	Clot		P-value
	Positive (n=20)	Negative (n=44)	

Gender	Male	6 (30%)	9 (20.5%)	0.403
	Female	14 (70%)	35 (79.5%)	
Age		34.68 ± 9.90	30.54 ± 7.56	0.78
Width		22.87 ± 6.63	22.32 ± 3.72	0.676
Depth		26.70 ± 6.63	26.68 ± 5.01	0.99
Ratio		0.88 ± 0.259	0.84 ± 0.142	0.053
RHYTHM	Atrial fibrillation	8 (40%)	3 (6.8%)	0.001
	Sinus Rhythm	12 (60%)	41 (93.2%)	

Table 3: Comparison of patients with presence or absence of clot

Discussion

Left atrial appendage acts like a gutter in left atrium. Blood once enters into it, has to come out of it. If the LAA is deep with narrow opening into left atrium especially in the presence of atrial fibrillation the blood stays there and leads to clot formation. In contrast if LAA is shallow with wide opening into left atrium and the patient is in sinus rhythm, blood can easily come out of it and no clot is formed. There are many factors which predispose to clot formation in LAA, including LAA outflow velocity, LAA shape and size. We studied LAA width to depth ratio and its association with clot formation. To best of our knowledge this parameter has not yet been studied.

There are different etiologies of clot formation in LAA. One of them is LAA outflow velocity. The velocity of less than 20 cm/sec is strongly associated with clot formation [3]. This also suggests that blood should flow at a good speed to come out of LAA. We have not studied this parameter in our patients. But with deeper LAA, it is difficult for blood to maintain its velocity to prevent stasis. Another study is required to assess the relation of depth of LAA to its outflow velocity.

Somerville et al. have shown that LAA size is associated with increased risk of stroke [5]. However Di Biase et al. did not support this finding in his study [2]. Whereas Ernst and Veinot et al. favor the finding that association does exist between the LAA size and the risk for stroke/TIA, especially in patients with nonvalvular AF [6,7]. In our study, Patients with valvular AF are more prone to clot formation if they have deeper LAA. So this controversial issue remains to be solved.

Anticoagulation used for valvular or non valvular AF has its own morbidity and mortality [8]. Left atrial appendage closure is advised for high-risk patients with non-valvular AF who have either contraindication for anticoagulation or are not suitable for long-term anticoagulant therapy, have increased bleeding risk, or they prefer an alternative [9-12].There must be some guidelines to address the issue that which LAA must be closed and which LAA may be left alone safely. Our study provides an insight into it and we think patients with deep LAA and narrow opening into LA should be considered for anticoagulants or LAA closure.

Study Limitations

Due to small sample size the findings of this study cannot be generalized, however this study provides a food for thought.

Dimensions measured are very sensitive, slight changes in angle or position of transesophageal probe can lead to variable results.

Future Perspective

LA appendage closure by surgical or percutaneous technique must take into account the depth and width of LA appendage. Deeper LA appendages with narrow opening into LA must be closed but shallow LA appendages with wide opening into LA may be left alone.

Conclusion

LAA is deep or shallow, it does not predispose to clot formation when in sinus rhythm but if the patient is in atrial fibrillation the deeper LAA with narrow opening into LA has more chances of clot formation.

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