Journal of Cardiovascular Disease Research

ISSN: 0975-3583, 0976-2833 VOL 14, ISSUE 09, 2023

The Effects of Percutaneous Mitral Balloon Valvuloplasty on the Left Atrial Appendage Function in Patients With Sinus Rhythm and Atrial Fibrillation : An observational study .

AUTHORS:

1. HARSH KUMAR: CONSULTANT, DEPARTMENT OF CARDIOLOGY, VASAL HOSPITAL, JALANDHAR
2. BALARAM CHOUDHARY: ASSISTANT PROFESSOR, DEPARTMENT OF CARDIOLOGY, GOVERNMENT MEDICAL COLLEGE, BARMER
3. NAVIDA BABBAR: SENIOR RESIDENT, DEPARTMENT OF CARDIOLOGY, SMS MEDICAL COLLEGE, JAIPUR, RAJASTHAN, INDIA.

ABSTRACT

- **BACKGR0UND:** LAA has an important pathophysiological function because it is more compliance than the LA and its contractile capacity prevents blood stasis.[1,2] LAA velocity is an important parameter that worsens in mitral stenosis. LAA velocity is an important predictor of thrombus formation, independent of other hemostatic variables, including platelet and thrombotic activity. The Effects of Percutaneous Mitral Balloon Valvuloplasty on the Left Atrial Appendage Function in Patients With Severe MS is studied in this article.

- **Results :** Of 50 patients 33 were in NSR and 17 were in AF. Female constituted 78 % and male 22% of study population. 72% of males were in AF whereas only 23% females were in AF with p value of 0.002. LVEF, LVEDD (P = 0.050) and LVESD (P =0.068) did not change significantly after PTMC. MVMG (P<0.001), MVEDG (P<0.001), and PASP (P<0.001) decreased significantly after PTMC with significant increase in MVA (P<0.001). LAA emptying velocity (LAAEV) and LAA filling velocity(LAAFV) were increased significantly (P<0.001).

- **Conclusion:** This study showed that PTMC is able to improve the clinical status, reduce SEC, and improve LAA function in patients with MS in both SR and AF rhythms. Therefore, PTMC may decrease the risk of thrombo-embolism by improving LA and LAA performance.

KEYWORDS: LAA VELOCITY, STROKE, PTMC

Background

Rheumatic mitral valve stenosis (MS) is a relatively common cause of valvular disease in developing countries such as India. MS is known to cause structural and functional abnormalities of the left atrium (LA) and left atrial appendage (LAA). Importantly, the

ISSN: 0975-3583, 0976-2833 VOL 14, ISSUE 09, 2023

LAA has an important pathophysiological function because it is more compliance than the LA and its contractile capacity prevents blood stasis.[1,2] LAA velocity is an important parameter that worsens in mitral stenosis.

LAA emptying velocity or LAA contraction flow(LAAEV) – is the most important wave during the sinus rhythm and occurs immediately after the P wave on the ECG. The diastolic emptying velocity is believed to result from active LAA contraction and is thus a marker of LAA contractile function. It correlates with LAA ejection fraction, LA size and pressure and is a significant predictor of thromboembolic risk. The average LAA contraction velocity is 50–60 cm/s.[3]

LAA filling velocity – This is a negative wave (away from the transducer) that occurs immediately following the LAA contraction and is a result of the combined effects of LAA relaxation and elastic recoil. The average LAA filling velocity is 40–50 cm/s and correlates well with the LAA contraction velocity[3]. Impaired function of the LAA, such as reduced flow velocity, typically results in LA thrombus formation, with LAA thrombi being more prevalent in presence of low velocities (<20 cm/s) than higher velocities (17% vs 5%, respectively).[4]

LAA velocity is an important predictor of thrombus formation, independent of other hemostatic variables, including platelet and thrombotic activity. The risk of cerebrovascular accident (CVA) increases in patients with rheumatic atrial fibrillation (AF) by 6- to 17- fold and the disturbed LAA and LA function in patients with MS in sinus rhythm (SR) can also increase the risk of CVA.[5] Mitral stenosis causes chronic pressure and volume overload, and LA myopathy. Eventually, it causes slow blood flow and blood stasis in the LAA and thrombus formation. Studies show that LAA performance improves within a short time after percutaneous mitral balloon valvotomy (PMBV) in patients with AF or in SR.[6,7]Recovery of LAA velocity after PTMC depends directly upon improving the mitral valve hemodynamics and reducing the trans-mitral gradient. Since its introduction PMBV has become established as a safe and effective treatment for rheumatic MS, with results that are equivalent to surgical valvotomy. In addition, transesophageal echocardiography (TEE) is a high-resolution imaging technique that can be used to evaluate the performance of LAA.

AIMS AND OBJECTIVES

- To study The Effects of Percutaneous Mitral Balloon Valvuloplasty on the Left Atrial Appendage Function in Patients With Severe MS.
- Comparison of LAA function in MS patients with SR and AF after PMBV.

ISSN: 0975-3583, 0976-2833 VOL 14, ISSUE 09, 2023

METHODS:

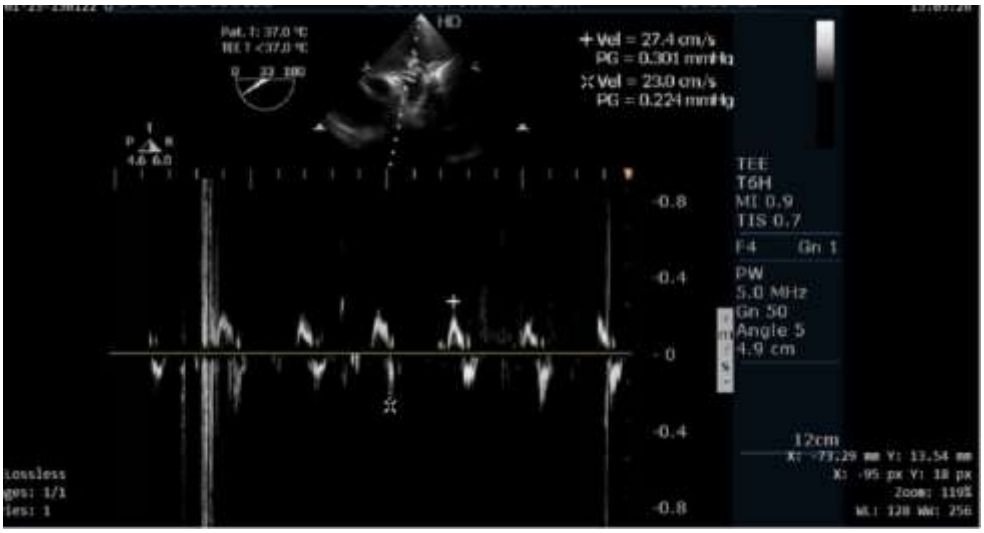
- INCLUSION CRITERIA: Patients with severe MS (valve area less than 1.5 cm^2) with sinus rhythm or Atrial fibrillation.
- EXCLUSION CRITERIA: Mitral regurgitation (mod to severe)
- LA and LAA thrombus
- Hypertension
- Diabetes mellitus
- Ischemic heart disease
- LVEF < 35%
- New York Heart Association (NYHA) functional class IV
- Patients who do not consent to TEE after PTMC.

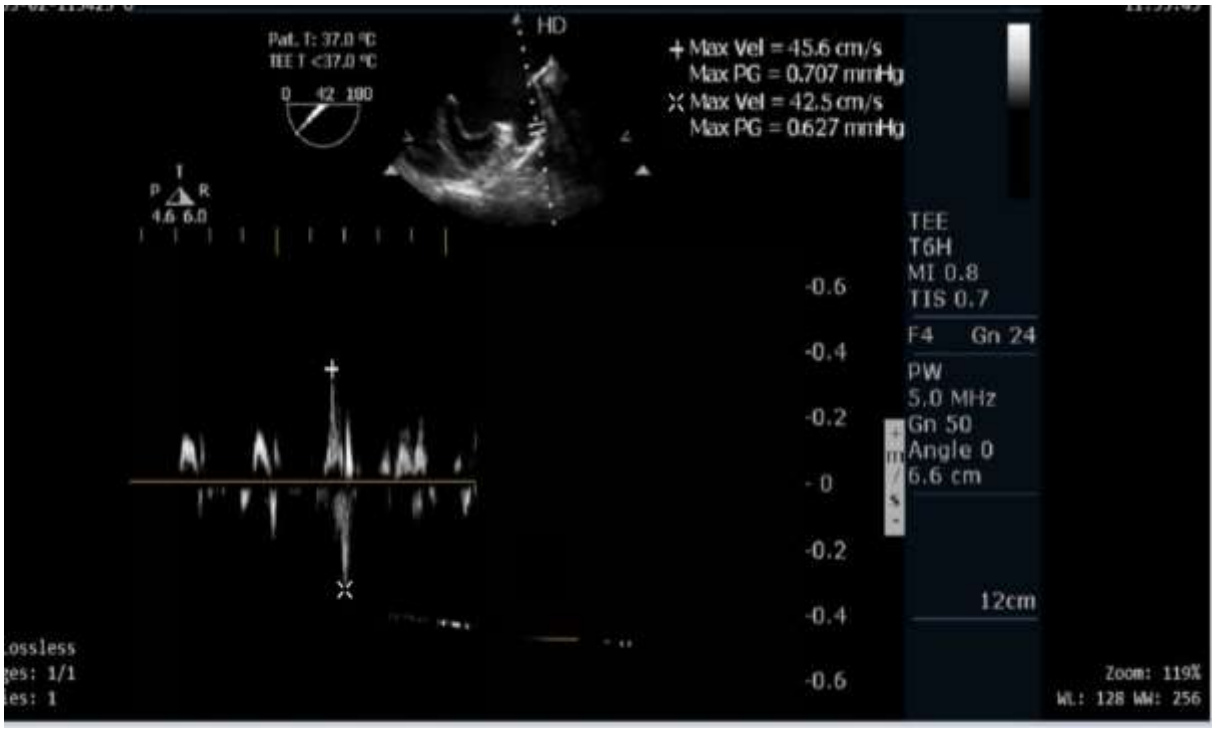
METHODOLOGY: TEE performed after overnight fasting before and one month after the PTMC.

- Measurement of LAA function done by measuring LAA emptying velocity(LAAEV) and LAA filling velocity(LAAFV).
- For measurement of LAA velocity sample volume, pulse wave (PW) Doppler is put in the mouth of the LAA.

  Comparison of LAA function before and one month after PTMC was done

ISSN: 0975-3583, 0976-2833 VOL 14, ISSUE 09, 2023





STATISTICAL ANALYSIS:

- Statistical evaluation was performed using latest version of SPSS software.
- Continuous variables were presented as mean ± SD and categorical variables as percentages.
- Comparison done by using student's T test(both paired and unpaired),chi square test and Wilcoxon signed rank test.
- The significance level adopted as p value < 0.05

ISSN: 0975-3583, 0976-2833 VOL 14, ISSUE 09, 2023

RESULTS:

Table 1

	NSR (n = 33)	AF (n = 17)	P value
Sex#			
M	**3 (9.1%)**	**8 (47.1%)**	**0.002***
F	**30 (90.9%)**	**9 (52.9%)**	
Age (Mean ± SD)	**29.91 ± 6.34**	**40.35 ± 7.01**	**<0.001****
Height (Mean ± SD)	**152.00 ± 6.66**	**155.65 ± 7.36**	**0.083**
Wilkins Score (Mean ± SD)	**7.97 ± 0.17**	**8.00 ± 0.35**	**0.685**

- Table 1 summarizes the baseline characteristics of the patient population.
- Of 50 patients 33 were in NSR and 17 were in AF.
- Female constituted 78 % and male 22% of study population.
- 72% of males were in AF whereas only 23% females were in AF with p value of 0.002.
- There was no statistical significant difference of height and wilkins score among NSR and AF group.

Table 2

	Before PTMC		After PTMC		P value
	Mean	**± SD**	**Mean**	**± SD**	
LVEF	**55.76**	**1.82**	**55.76**	**1.82**	**-**
LVEDD	**42.42**	**2.22**	**41.70**	**1.47**	**0.050**
LVESD	**30.33**	**2.38**	**29.58**	**2.21**	**0.068**

ISSN: 0975-3583, 0976-2833 VOL 14, ISSUE 09, 2023

MVA	**1.12**	**0.21**	**1.64**	**0.20**	**<0.001****
MDG	**13.45**	**2.18**	**6.58**	**1.28**	**<0.001****
EDG	**7.33**	**1.49**	**3.91**	**0.95**	**<0.001****
PASP	**48.24**	**9.51**	**32.33**	**8.15**	**<0.001****
LAAEV	**27.33**	**4.29**	**40.90**	**3.66**	**<0.001****
LAAFV	**23.57**	**4.36**	**36.39**	**4.93**	**<0.001****

- Table 2 shows the comparison of echocardiographic variables before and after PTMC in patients with NSR.
- LVEF, LVEDD (P = 0.050) and LVESD (P =0.068) did not change significantly after PTMC.
- MVMG (P<0.001), MVEDG (P<0.001), and PASP (P<0.001) decreased significantly after PTMC with significant increase in MVA (P<0.001).
- LAA emptying velocity (LAAEV) and LAA filling velocity(LAAFV) were increased significantly (P<0.001).

Table 3

	Before PTMC		**After PTMC**		**P value**
	Mean	**± SD**	**Mean**	**± SD**	
LVEF	**53.24**	**2.46**	**54.12**	**1.97**	**0.165**
LVEDD	**42.41**	**2.69**	**41.65**	**1.69**	**0.012**
LVESD	**31.35**	**3.30**	**30.53**	**1.77**	**<0.014**
MVA	**1.16**	**0.22**	**1.68**	**0.18**	**<0.001****
MDG	**12.76**	**2.11**	**6.24**	**0.90**	**<0.001****
EDG	**6.76**	**1.48**	**3.06**	**0.66**	**<0.001****
PASP	**50.29**	**8.32**	**34.35**	**6.06**	**<0.001****
LAAEV	**24.12**	**4.24**	**30.23**	**4.83**	**<0.001****

ISSN: 0975-3583, 0976-2833 VOL 14, ISSUE 09, 2023

LAAFV	**22.88**	**3.48**	**28.41**	**4.08**	**<0.001****

- Table 3 shows results for the AF group which were comparable to NSR group.
- LVEF(0.165), LVEDD (P = 0.059) and LVESD (P =0.064) did not change significantly after PTMC.
- MVMG (P<0.001), MVEDG (P<0.001), and PASP (P<0.001) decreased significantly after PTMC with significant increase in MVA (P<0.001).
- LAA emptying velocity (LAAEV) and LAA filling velocity(LAAFV) were increased significantly (P<0.001).

Table 4

	SEC	**NSR**		**AF**		**P value[#]**
		N	%	N	%	0.118
Before PTMC	No	23	69.7	8	47.1	
	Yes	10	30.3	9	52.9	
After PTMC	No	29	87.9	11	64.7	0.052
	Yes	4	12.1	6	35.3	
Before PTMC vs After PTMC (p Value)		0.014*		0.083		

- TABLE 4. shows SEC in 10(30%) SR patients and 9(53%) AF patients, which completely disappeared in 6 and 3 patients, respectively.

DISCUSSION

- In MS, chronic tension in the LA and LAA from volume and pressure overload results in electrophysiological and electro-anatomical changes.[8]
- PTMC can improve these changes by rapid decline in left atrial afterload.
- In this study AF was more common in males as compare to females. Reason for increased prevalence in males can be due to increased age at the time of intervention(mean age in male 46 years as compare to 30 years in females)

ISSN: 0975-3583, 0976-2833 VOL 14, ISSUE 09, 2023

- Also there was significant reduction in MVMG and MVEDG after PTMC in both the SR and AF groups
- LAA velocity is an important parameter that worsens in mitral stenosis.
- Tenekecioglu et al. reported that the LAA pulsed-Doppler emptying velocity was > 60 cm/s in normal healthy controls. [9]
- Sahin et al. compared the LAA velocities in AF patients with MS to those in healthy controls in SR and found that LAA Doppler velocities were significantly decreased in patients with MS (peak ejection velocity 24 ± 6 cm/s vs 61 ± 16 cm/s).[10]
- Those data suggest the existence of dysfunction of the LAA in the MS and reflect a disturbed function ability of that structure.
- In this study, the LAAEV and LAAFV before PTMC in both the SR and AF groups was lower than normal, and we found a significant increase in LAAEV and LAAFV after PTMC.
- The increase in LAAEV occurred in both groups but this increase was more dramatic in the SR group than in the AF group.
- These results are similar to the results obtained by Karakaya et al.[11] and Tatani S.B et al. [12] that found a significant improvement of the left appendicular flow after the PTMC.
- In MS patients, the low shear and flow-velocity condition leads to red blood cells aggregation through binding between red blood cells and plasma proteins. Thus, SEC can appear in the LA and subsequently increase LA clot formation and embolic phenomenon.[13]
- In our study, we observed SEC in 10(30%) SR patients and 9(53%) AF patients, which completely disappeared in 6 and 3 patients, respectively.

Conclusion:

- This study showed that PTMC is able to improve the clinical status, reduce SEC, and improve LAA function in patients with MS in both SR and AF rhythms.
- Therefore, PTMC may decrease the risk of thrombo-embolism by improving LA and LAA performance.
- However, these findings should be confirmed by further large-scale studies and long-term follow-up.

ISSN: 0975-3583, 0976-2833 VOL 14, ISSUE 09, 2023

LIST OF ABBREVIATIONS:

AF- ATRIAL FIBRILLATION

SR- SINUS RHYTHM

SEC- SPONTANEOUS ECHO CONTRAST

LAA- LEFT ATRIAL APPENDAGE

LA- LEFT ATRIUM

PTMC- PERCUTANEOUS TRANSMITRAL COMMISUROTOMY

MS- MITRAL STENOSIS

LAAEV- LAA emptying velocity

LAAFV- LAA filling velocity

MVMG- MITRAL VALVE MEAN GRADIENT

MVEDG- MITRAL VALVE END DIASTOLIC GRADIENT

REFERENCES:

1.Tabata T, Oki T, Yamada H. Role of left atrial appendage in left atrial reservoir function as evaluated by left atrial appendage clamping during cardiac surgery. Am J Cardiol. 1998;81:327–332. doi: 10.1016/s0002-9149(97)00903-x.

2. Al-Saady NM, Obel OA, Camm AJ. Left atrial appendage: structure, function, and role in thromboembolism. Heart. 1999;82:547–554. doi: 10.1136/hrt.82.5.547.

3.Tabata T., Oki T., Fukuda N. Influence of aging on left atrial appendage flow velocity patterns in normal subjects. J Am Soc Echocardiogr. 1996;9:274–280.

4. Daimee MA, Salama AL, Cherian G, Hayat NJ, Sugathan TN. Left atrial appendage function in mitral stenosis: is a group in sinus rhythm at risk of thromboembolism? Int J Cardiol. 1998;66:45–54. doi: 10.1016/s0167-5273(98)00128-4.

5. Porte JM, Cormier B, Iung B. Early assessment by transesophageal echocardiography of left atrial appendage function after percutaneous mitral commissurotomy. Am J Cardiol. 1996;77:72–76. doi: 10.1016/s0002-9149(97)89137-0.

6. Lin JM, Hsu KL, Hwang JJ, Li YH, Tseng YZ. Effects of percutaneous mitral valvuloplasty on left atrial appendage flow velocity. Am J Cardiol 76. 1995;76:609–611. doi: 10.1016/s0002-9149(99)80167-2.

ISSN: 0975-3583, 0976-2833 VOL 14, ISSUE 09, 2023

7. John B, Stiles MK, Kuklik P. Reverse remodeling of the atria after treatment of chronic stretch in humans: Implications for the atrial substrate. **J Am Coll Cardoiol** 2010;55:1217–1226.

8.Garcia-Fernandez MA, Torrecilla EG, San Roman D. Left atrial appendage Doppler flow patterns Implications on thrombus formation. Am Heart J. 1992;124:955–96.

9.Tenekecioglu E, Karabulut A, Yılmaz M. Comparison of tissue Doppler dynamics with Doppler flow in evaluating left atrial appendage function by transesophageal echocardiography in prehypertensive and hypertensive patients. **Echocardiography** 2010;27:677–686.

10. Sahin T, Ural D, Kilic T. Evaluation of left atrial appendage functions according to different etiologies of atrial fibrillation with a tissue Doppler imaging technique by using transesophageal echocardiography. **Echocardiography** 2009;26:171–181.

11. Karakaya O, Turkmen M, Bitigen A. Effect of percutaneous mitral balloon valvuloplasty on left atrial appendage function: a Doppler tissue study. **J Am Soc Echocardiogr** 2006;19:434–437.

12.Tatani SB, Campos Filho O, Fischer CH. Functional assessment of left atrial appendage with transesophageal echocardiography before and after percutaneous valvotomy in the mitral stenosis. **Arq Bras Cardiol** 2005;84:457–460.

12. Inci S, Erol MK, Taş MH, Bakırcı EM, Hamur H, Karakelleoğlu S. Early- and mid-term effects of percutaneous mitral balloon valvuloplasty on left atrial mechanical functions in mitral stenosis. **Turk Kardiyol Dern Ars** 2014;42(6):517-23. doi: 10.5543/tkda.2014.09147

13. Ganeswara Reddy V, Rajasekhar D, Vanajakshamma V. Effect of percutaneous mitral balloon valvuloplasty on left atrial appendage function: Transesophageal echo study. **Indian Heart J** 2012; 64(5): 462–468. doi: 10.1016/j.ihj.2012.07.008