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Clinical Hemodynamic and Echocardiography Data Analysis for Patients with Mitral Stenosis Before and After PTMC Procedure at Rajaie Cardiovascular Center Between 2015 and 2016

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Abstract

Background: Mitral stenosis is a common and important type of valvular heart disease. This study was performed to determine and compare the hemodynamic, echocardiographic and clinical data before and after percutaneous transvenous mitral commissurotomy (PTMC).

Methods: In this prospective cohort, the data for 171 consecutive patients with PTMC at a university referral heart hospital have been collected and analyzed from March 2015 till September 2016. Due to the missing data reported on the medical charts, 20 cases were further dismissed. Therefore, clinical study on hemodynamic monitoring and echocardiography have been observed and compared on the remaining 151 consecutive cases. In this study, demographic data, clinical symptoms and medication before the procedure and systolic pulmonary arterial pressure (SPAP), pulmonary capillary wedge pressure (PCWP), trans mitral valve gradient and mitral valve area (MVA) before and after PTMC have been measured.

Results: The results showed that according to Wilcoxon test there was a significant increase in PCWP, significant decrease in mean gradient of mitral valve and significant reduction in SPAP after PTMC ($P = 0.0001$). In this study, post-procedure mitral regurgitation (MR) values after echocardiography and angiography have been compared and it was stated that about 90.4% (138 cases) are diagnosed with mild MR (no MR and mild MR) in angiography while 10.6% (16 cases) have trivial and mild MR in echocardiography ($P < 0.0001$).

Conclusions: Totally it may be concluded that there is significant difference between the hemodynamic and echocardiographic data after PTMC. Echocardiography estimates the MR complications after PTMC to be higher than angiography.

Keywords: Echocardiography, Percutaneous Transvenous Mitral Commissurotomy, Mitral Stenosis, Mitral Regurgitation, Pulmonary Capillary Wedge Pressure, Mitral Valve Area

1. Background

Mitral stenosis (MS) is a common cause of congestive heart failure worldwide especially in developing countries (1-4). Possible etiological factors include rheumatic fever, calcium deposition, congenital heart disease, endocarditis, mucopolysaccharidosis, etc. (5-7). It is more common among female patients especially in ages ranging from 4 to 14 years but the onset age of symptoms is in the third life decade (8-10). Without operation the disease would be fatal during two decades due to complications especially atrial fibrillation and thromboembolia (11-15). Echocardiography is the first and most accurate method for diagnosis of MS (16, 17). Percutaneous transvenous mitral commissurotomy (PTMC) is the method of choice in non-responsive cases to medical modalities and symptomatic severe MS who have suitable mitral valve (MV) morphology on echocardiography (18). The principle of PTMC is that when the fluid filled balloon is expanded, equal pressure is applied to the MV, resulting in separation along the plane of least resistance, which are the commissures (18, 19). PTMC can also be considered in patients with asymptomatic MS, with significant hemodynamic changes and

has a suitable mitral valve morphology on echo (19-21). PTMC is not performed in patients with a large atrium thrombus, moderate to severe (3+ or 4+) mitral regurgitation, mitral valve area larger than 1.5 cm^2, aortic regurgitation more than 2+, infective endocarditis, severe mitral valve calcification, or subvalvular fibrosis who are surgical candidates (21, 22). Successful PTMC is an uncomplicated procedure with a final mitral valve area > 1.5 cm^2 with a large atrial pressure of < 18 mmHg. This usually occurs in 80% to 90% of cases and leads to an immediate symptomatic relief with a 50% to 60% decrease in transmitral gradient. Over a few months, there is a gradual regression in pulmonary artery pressure. Post-PTMC in patients with a Wilkins score greater than 8 have a higher recurrence rate of symptoms as a result of restenosis or inadequate valvuloplasty (19-22).

2. Objectives

This study was performed to determine and compare the hemodynamic clinical and echocardiographic data before and after PTMC.

3. Methods

In this observational study that was accomplished with a prospective cohort design, the data for 171 consecutive patients with PTMC at Shahid Rajaie Cardiovascular Medical and Research Center have been collected and analyzed from March 2015 till September 2016. Due to the missing data reported on the medical charts, 20 cases were further dismissed. Therefore, clinical study on hemodynamic monitoring and echocardiography have observed and compared on the remaining 151 consecutive cases.

Data analysis was performed among 151 subjects in by SPSS (version 24.0) software (Statistical Procedures for Social Sciences; Chicago, Illinois, USA). Kolmogorov-Smirnov, Wilcoxon, Feridman, Spearman tests were used and were considered statistically significant at P values less than 0.05.

4. Results

In this study 20.1% of patients were male and the mean age was 45.5 ± 12.3 years. The mean body surface area (BSA), heart rate, systolic blood pressure, and diastolic blood pressure were 1.7 ± 0.2, 77.2 ± 13.1, 119.6 ± 14.7, and 74.9 ± 7.3. The mean pulmonary capillary wedge pressure before and after PTMC was 11.9 ± 6.6 and 23.02 ± 9.1, respectively (P = 0.0001). Also the mean SPAP before and after PTMC was 44.3 ± 12.9 and 39.4 ± 14.2, respectively (P = 0.0001). The mean mitral valve gradient before and after PTMC was 16.3 ± 5.9 and 1.6 ± 2.2, respectively (P = 0.0001). After PTMC the mitral regurgitation severity was altered as shown in Tables 1-5.

The dyspnea on exertion (DOE) was functional class one to four in 16.8%, 42.3%, 38%, and 2.9%, respectively. Palpitation, fatigue, and chest pain were seen in 54.3%, 32.5%, and 36.4%, respectively. Beta-blockers, calcium channel blockers, and diuretics were used in 68%, 33.3%, and 49.7%, respectively. The mean pressure half time (PHT) was decreased from 217.5 ± 58.4 to 147.4 ± 42.7 (P = 0.0001). The mean planimetry was increased from 0.9 ± 0.2 to 1.4 ± 0.2 (P = 0.0001). The mean SPAP was decreased from 48.9 ± 12.9 to 38.7 ± 15.5 (P = 0.0001).

The Wilkins score was 7 in 13.3%, 7 - 8 in 0.7%, 8 in 13.3%, 8 - 9 in 14.7%, 9 in 38%, 9 - 10 in 18%, and 11 - 12 in 2%. The mean MV area and left atrium measurements in the patients are shown in Table 6.

Complication of this procedure, tamponade, severe mitral regurgitation, atrial septal defect, and mortality were seen in 3.3%, 5.3%, 29.8%, and zero percent, respectively (Table 7).

Among 151 patients observed under PTMC, the MR severity after PTMC based on angiography distributed as follows: 92 cases (60.9%) no MR, 46 cases (30.5%) mild MR, 7 cases (4.6%) moderate MR and 4 cases (2.6%) with severe MR. However mitral valve regurgitation grade was significantly different compared to angiography. Based on echocardiography data after PTMC, the results were reported as 5 cases (3.3%) trivial MR, 11 cases (7.3%) mild MR, 131 cases (86.8%) moderate MR and 4 cases (3.6%) with severe MR. Although the difference between post-procedure MR values in echocardiography and angiography is expected, the analysis (P < 0.0001) explains the difference is very significant, for example, severe MR has a similar number in both groups while mild MR cases increase from 7 in angiography to 131 in echocardiography.

5. Discussion

The results demonstrated that the results of angiography method and echocardiography were differed. The MR value difference in echocardiography and angiography has been observed and analyzed in several studies and has shown similar results (19-22). In a 2004 study it was concluded that in limited cases in which non-invasive evaluations do not agree with the clinical findings, the angiography will be accurate to measure the MR level. Another study at McGraw-Hill Education Company has demonstrated that the valve regurgitation measurement with angiography method depends on various factors including the amount and the injection speed of the contrast

Table 1. MV Area in Echocardiography Before and After PTMC

Descriptive Statistics	N	Minimum	Maximum	Mean	Std. Deviation
MVA before PTMC by echo	151	0.43	1.40	0.9393	0.21423
MVA after PTMC by echo	149	0.85	2.12	1.4098	0.22742
Valid N (listwise)	149				

Table 2. MR Severity Before PTMC in Angiography

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid				
No	113	74.8	75.3	75.3
Mild	33	21.9	22	97.3
Moderate	4	2.6	2.7	100.0
Total	150	99.3	100.0	
Missing				
System	1	0.7		
Total	151	100.0		

Table 3. MR Severity After PTMC in Angiography

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid				
No	92	60.9	61.7	61.7
Mild	46	30.5	30.9	92.6
Moderate	7	4.6	4.7	97.3
Severe	4	2.6	2.7	100.0
Total	149	98.7	100.0	
Missing				
System	2	1.3		
Total	151	100.0		

Table 4. MR Severity Before PTMC in Echocardiography

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid				
No	12	7.9	8.1	8.1
Mild	114	75.5	77.6	85.7
Moderate	20	13.2	13.6	99.3
Severe	1	0.7	0.7	100.0
Total	147	97.4	100.0	
Missing				
System	4	2.6		
Total	151	100.0		

material into the left atrium that vary at different centers with different operators which significantly reduce the accuracy of MR measurement. Grossman and Baim have explained that the main reason for difference in regurgita-

Table 5. MR Severity After PTMC in Echocardiography

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid				
Trivial	5	3.3	3.3	3.3
Mild	11	7.3	7.3	10.6
Moderate	131	86.8	86.8	97.4
Severe	4	2.6	2.6	100.0
Total	151	100	100.0	
Missing				
System	0	0		
Total	151	100.0		

Table 6. The MVA and LA Measurements in the Patients

	Minimum	Maximum	Mean	Std. Deviation
MVA by planimetery echocardiography	0.43	1.40	0.9393	0.21423
MVA by PHT echocardiography	0.57	3.60	1.0820	0.33485
MVA by 3D TEE echocardiography	0.45	175.00	2.6989	17.67789
LA area echocardiography	15.00	60.00	28.3635	6.87578
LA diameter echocardiography	2.44	7.30	4.3770	0.69009

Table 7. Complication

Valid	Frequency	Percent	Valid Percent	Cumulative Percent
Tamponade Complication				
No	146	96.7	96.7	96.7
Yes	5	3.3	3.3	100.0
Total	151	100.0	100.0	
Severe MR Complication				
No	147	97.4	97.4	97.4
Yes	4	2.6	2.6	100.0
Total	151	100.0	100.0	
Death				
No	151	100.0	100.0	100.0
ASD				
No	106	70.2	70.2	70.2
ASD	45	29.8	29.8	100.0
Total	151	100.0	100.0	

tion is the location of the catheter into the left ventricle and aorta that is used for MR and AI level measurement, respectively (22).

Several causes of this significant discrepancy between echocardiography and angiography about post PTMC mitral regurgitation was discussed in some articles including: the quantity of contrast material (volume and speed of injection) is proportional of density and if this is small, it may downregulate the grade of regurgitation; the arrhythmia (ventricular extra-beats or atrial fibrillation, or even that produced by the catheter itself) significantly affects the ventricular filling and subsequently the indicated grade of regurgitation; although mild regurgitation is clearly distinct from severe regurgitation, inter-

mediate grades may not be reliably estimated; the position of catheter in the ventricle (for mitral valve) or in the aorta (for aortic valve), in relation to the site of valve; the recorded plane of ventricle and/or atrium, to avoid overlapping (23). The "ideal" plan for estimation of aortic regurgitation is that of 45° in left anterior oblique view with 10% - 15% of cranial angulation, while for mitral regurgitation it is a 30° in right anterior oblique view; avoiding the overlapping of descending thoracic aorta and left atrium which may overestimate the mitral regurgitation; avoiding derangements of preload and afterload (systemic and pulmonary vascular resistance for aortic and mitral valve, respectively) which significantly affects the grade of regurgitation; the coexistence of mitral and aortic regurgitation can change the regurgitant contrast volume through mitral valve and therefore overestimates the grade of its regurgitation.

In the practical view, it is important to observe how significant the difference between echocardiography and angiography on patient treatment plan is. In this study, there has been a medical follow up in each case of MR increase due to the PTMC procedure. In other words, although a significant increase in the MR level has been observed on the patients' echocardiography tests, the patients are not expected to receive MVR surgery while the medical treatments vary based on clinical symptoms. Four patients have been observed with severe MR during angiography and echocardiography test evaluation which resulted in MVR while the remaining patients have received medical treatment despite increase in grading regurgitation. It is worth noting that this discrepancy has not changed the patients' medical plan. Although there are several techniques to increase the accuracy of the conventional methods and on the other hand, new approaches have been developed to reduce the miscalculations in the post PTMS complications, this research has clearly explained that the effects of the errors do not significantly affect the survival expectation for the patients group.

Totally, according to the results, it may be concluded that there is a significant difference between the angiographic and echocardiographic data before and after PTMC. These differences are due to multiple etiological factors and should be considered at further evaluations in these patients. However further studies should be carried out to attain more definite results.

References

1. Maganti K, Rigolin VH, Sarano ME, Bonow RO. Valvular heart disease: Diagnosis and management. *Mayo Clin Proc*. 2010;**85**(5):483–500. doi: 10.4065/mcp.2009.0706. [PubMed: 20435842]. [PubMed Central: PMC2861980].
2. Shipton B, Wahba H. Valvular heart disease: Review and update. *Am Fam Physician*. 2001;**63**(11):2201–8. [PubMed: 11417772].
3. Chandrashekhar Y, Westaby S, Narula J. Mitral stenosis. *Lancet*. 2009;**374**(9697):1271–83. doi: 10.1016/S0140-6736(09)60994-6. [PubMed: 19747723].
4. Yukawa S, Takeuchi M, Nakazono A, Sakamoto K, Araya K, Eto M, et al. Mitral stenosis reversed by medical treatment for heart failure. *Ann Thorac Surg*. 2013;**96**(5):e115–7. doi: 10.1016/j.athoracsur.2013.04.132. [PubMed: 24182508]. [PubMed Central: PMC4281521].
5. Feldman T. Rheumatic mitral stenosis. On the rise again. *Postgrad Med*. 1993;**93**(6):93–4. 99-104. [PubMed: 8483828].
6. Iung B, Vahanian A. [Mitral stenosis]. *Ann Cardiol Angeiol (Paris)*. 2003;**52**(2):117–24. French. [PubMed: 12754970].
7. Fassbender D, Schmidt HK, Seggewiss H, Mannebach H, Bogunovic N. [Diagnosis and differential therapy of mitral stenosis]. *Herz*. 1998;**23**(7):420–8. German. [PubMed: 9859036].
8. Rayburn BK, Fortuin NJ. Severely symptomatic mitral stenosis with a low gradient: A case for low-technology medicine. *Am Heart J*. 1996;**132**(3):628–32. [PubMed: 8800035].
9. Pierard LA, Lancellotti P. Stress testing in valve disease. *Heart*. 2007;**93**(6):766–72. doi: 10.1136/hrt.2005.074815. [PubMed: 17502660]. [PubMed Central: PMC1955215].
10. Farman MT, Sial JA, Khan N, Rahu QA, Tasneem H, Ishaq M. Severe mitral stenosis with atrial fibrillation a harbinger of thromboembolism. *J Pak Med Assoc*. 2010;**60**(6):439–43. [PubMed: 20527639].
11. Gonzalez-Torrecilla E, Garcia-Fernandez MA, Perez-David E, Bermejo J, Moreno M, Delcan JL. Predictors of left atrial spontaneous echo contrast and thrombi in patients with mitral stenosis and atrial fibrillation. *Am J Cardiol*. 2000;**86**(5):529–34. [PubMed: 11009271].
12. Keren G, Etzion T, Sherez J, Zelcer AA, Megidish R, Miller HI, et al. Atrial fibrillation and atrial enlargement in patients with mitral stenosis. *Am Heart J*. 1987;**114**(5):1146–55. [PubMed: 2960225].
13. Sanada J, Komaki S, Sannou K, Tokiwa F, Kodera K, Terada H, et al. [Significance of atrial fibrillation, left atrial thrombus and severity of stenosis for risk of systemic embolism in patients with mitral stenosis]. *J Cardiol*. 1999;**33**(1):1–5. Japanese. [PubMed: 10028455].
14. De Gevigney G; Groupe de travail sur les valvulopathies de la Societe francaise de cardiologi. [The best of valvular heart disease in 2006]. *Arch Mal Coeur Vaiss*. 2007;**100 Spec No 1**:19–28. French. [PubMed: 17405561].
15. Cardoz J, Jayaprakash K, George R. Mitral stenosis and acute ST elevation myocardial infarction. *Proc (Bayl Univ Med Cent)*. 2015;**28**(2):207–9. [PubMed: 25829656]. [PubMed Central: PMC4365122].
16. Omran AS, Arifi AA, Mohamed AA. Echocardiography in mitral stenosis. *J Saudi Heart Assoc*. 2011;**23**(1):51–8. doi: 10.1016/j.jsha.2010.07.007. [PubMed: 23960637]. [PubMed Central: PMC3727554].
17. Izgi C, Ozdemir N, Cevik C, Ozveren O, Bakal RB, Kaymaz C, et al. Mitral valve resistance as a determinant of resting and stress pulmonary artery pressure in patients with mitral stenosis: A dobutamine stress study. *J Am Soc Echocardiogr*. 2007;**20**(10):1160–6. doi: 10.1016/j.echo.2007.02.006. [PubMed: 17570635].
18. Carabello BA. Modern management of mitral stenosis. *Circulation*. 2005;**112**(3):432–7. doi: 10.1161/CIRCULATIONAHA.104.532498. [PubMed: 16027271].
19. Kamada M, Ohsaka K, Nagamine S, Kakihata H. Mitral valve replacement after percutaneous transluminal mitral commissurotomy. *Jpn J Thorac Cardiovasc Surg*. 2004;**52**(7):335–8. doi: 10.1007/s11748-004-0065-4. [PubMed: 15296029].
20. Ben Farhat M, Boussadia H, Gandjbakhch I, Mzali H, Chouaieb A, Ayari M, et al. Closed versus open mitral commissurotomy in pure noncalcific mitral stenosis: Hemodynamic studies before and after operation. *J Thorac Cardiovasc Surg*. 1990;**99**(4):639–44. [PubMed: 2319784].
21. Hasan-Ali H, Shams-Eddin H, Abd-Elsayed AA, Maghraby MH. Echocardiographic assessment of mitral valve morphology after percutaneous transvenous mitral commissurotomy (PTMC). *Cardiovasc Ultrasound*. 2007;**5**:48. doi: 10.1186/1476-7120-5-48. [PubMed: 18067671]. [PubMed Central: PMC2248162].

22. Sadeghian H, Salarifar M, Rezvanfard M, Nematipour E, Lotfi Tokaldany M, Safir Mardanloo A, et al. Percutaneous transvenous mitral commissurotomy: Significance of echocardiographic assessment in prediction of immediate result. *Arch Iran Med*. 2012;**15**(10):629–34. [PubMed: 23020539].

23. Bahl VK, Chandra S, Jhamb DK, Goswami KC, Juneja R, Thatai D, et al. Balloon mitral valvotomy: Comparison between antegrade Inoue and retrograde non-transseptal techniques. *Europ Heart Journal*. 1997;**18**(11):1765–70. doi: 10.1093/oxfordjournals.eurheartj.a015171.