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Evaluation of the impact of successful percutaneous balloon mitral valvuloplasty on the left ventricular twist and untwist mechanics by the two dimensional speckle tracking imaging (Comparative study between Inoue and multi-track balloon mitral valvuloplasty techniques)

Saied Shalaby Montaser
Cardiovascular Disease Department, Faculty of Medicine, Menoufia University, Egypt

Mahmoud Kamel Ahmad
Cardiovascular Disease Department, Faculty of Medicine, Menoufia University, Egypt

Morad Bishay Mina
Cardiovascular Disease Department, Faculty of Medicine, Menoufia University, Egypt

Ahmad Gabr Buraik
Cardiovascular Disease Department, Faculty of Medicine, Menoufia University, Egypt
Corresponding author email: Agbraik@gmail.com

Abstract*---Background*: MS is one of the most prevalent valve abnormalities in people with chronic rheumatic heart disease (RHD). The effect of Inoue and multi-track successful percutaneous balloon mitral valvuloplasty (PBMV) on the twist and untwist mechanisms of the left ventricle was evaluated using non-invasive two-dimensional speckle tracking imaging (STI). *Methods*: This study was conducted on patients with mitral stenosis of rheumatic origin fulfilling the criteria for PBMV. Cases were categorized into two equal groups; group 1: 30 Patients underwent PBMV using Inoue technique and group 2: 30 Patients underwent PBMV using multi-track technique. All patients were subjected to full history and clinical examination, twelve leads surface electrocardiogram (ECG) before and after the procedure, two-

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dimensional and Doppler echocardiography, LV twist and untwist measured by the 2D the two-dimensional speckle tracking imaging (STI) before and after the procedure and PBMV. *Results:* In both techniques; the mitral valve area (MVA) was highly significantly increased after balloon mitral valvuloplasty (BMV), while mean pressure gradient (MPG) and the estimated systolic pulmonary artery pressure (PAP) were highly significantly decreased. The apical rotation, basal rotation, twist and untwist were highly significantly decreased after the procedure in each technique. Mitral regurgitation (MR) was significantly increased after BMV in each technique. Regarding the onset of new arrhythmias, there was no noticeable difference between the two methodologies. *Conclusion:* LV ejection fraction (EF%) does not improve acutely after BMV. Left ventricular twist and untwist mechanics decrease after PBMV, but no difference is documented between the two techniques. MR and new onset arrhythmias are documented complications of PBMV in both techniques; despite the increased severity of MR in both techniques after BMV, there was no significant difference found between them.

***Keywords*---**Percutaneous Balloon Mitral Valvuloplasty, Left Ventricular Mechanics, Two-Dimensional Speckle Tracking Imaging.

Introduction

Rheumatic heart disease (RHD) is one of the most common kinds of cardiac sickness in the world, particularly in developing countries, where it is the second biggest cause of cardiovascular morbidity and mortality, behind atherosclerotic vascular disease. Recent research has shown the unsettling possibility of a RHD resurgence, even in prosperous nations where it has been almost eradicated [1-3]. Mitral stenosis (MS) is one of the most prevalent valve lesions seen in patients with chronic RHD, and it often presents with exertional dyspnea and signs of right heart failure due to pulmonary venous congestion and, eventually, pulmonary arterial hypertension. In contrast to mitral regurgitation (MR), aortic stenosis, and aortic regurgitation, mitral stenosis (MS) does not provide a significant hemodynamic burden on the left ventricle (LV); hence, LV systolic dysfunction is a relatively rare occurrence in patients with M [4-10].

In the ultrasonic window, speckle-tracking echocardiography (STE) analyses motion by monitoring natural acoustic reflections and interference patterns. The image processing approach follows 20 to 40 pixel blocks with consistent patterns known as "speckles", "markers", "patterns", "features", or "fingerprints." Using a sum-of-absolute-differences approach, speckles are tracked progressively frame by frame to resolve angle-independent two-dimensional (2D) and three-dimensional (3D) tissue motion and deformation sequences [11-14].

LV torsion is the heart's twisting motion caused by the contraction of its oblique spiral fibres [15, 16]. During systolic ejection, counterclockwise torsion develops, while the bulk of deformation that happens during the isovolumic relaxation phase consists of clockwise recoil of torsion, or untwisting [17]. This recoil is related to the release of accumulated restorative forces during systole and is believed to contribute to diastolic suction, the most significant predictor of early LV filling [18, 19]. Recent advancements in two-dimensional ultrasonic speckle tracking imaging (STI) have allowed for non-invasive measurements of LV strain, strain rate, and twist [13].

Inoue et al. reported the first percutaneous mitral valvotomy in 1984. (PMV). Using a catheter with an inflated balloon, he reduced the size of the vascular access and the atrial septum hole after trans-septal transit. Later, novel procedures using single catheters with double or two-balloon catheters on two independently positioned guidewires were developed [20]. The purpose of this research is to investigate the effect of Inoue and multi-track successful percutaneous balloon mitral valvuloplasty (PBMV) on the left ventricular twist and untwist processes utilising non-invasive two-dimensional STI.

Methods

This research was done on individuals with MS of rheumatic aetiology who met the criteria for PBMV at Menoufia University Hospital's Cardiovascular Department. The cases' written informed consent was acquired. The Ethics Committee of the Faculty of Medicine at Menoufia University authorised the research. Patients with a New York Heart functional class of greater than or equal to II and less than or equal to IV met the inclusion criteria. Moderate to severe MS (i.e., a mitral valve area (MVA) 61 cm^2/m^2 BSA or <1.5 cm2 in normal-sized people [21]. a valve with the appropriate morphology based on echocardiographic data. Sinus rhythm and atrial fibrillation are present. Absence of concomitant cardiovascular disease requiring surgical intervention. Exclusion criteria included systemic hypertension, diabetes, more than mild mitral or aortic regurgitation and/or stenosis, pulmonary valve disease, lung diseases, prior aortic or mitral valve surgery, echocardiographic criteria for contraindications of balloon valvuloplasty such as MR grade III or IV, heavily calcified mitral valve annulus, left atrial thrombus, commissural calcification, and heavy subvalvular calcification [22].

Cases were categorized into two equal groups; group 1: Thirty patients who were underwent balloon mitral valvuloplasty (BMV) using Inoue technique and group 2: Thirty patients who underwent BMV using multi-track technique. All patients were subjected to: Full history and clinical examination. Twelve leads surface ECG before and after the procedure. Echocardiographic measurements: All patients were examined in the left lateral decubitus position by M-mode, two-dimensional and Doppler echocardiography before and immediately (within 24 h) after the procedure.

The following variables have been chosen for analysis: Left atrial diameter (LAD): Using M-mode and two-dimensional measurements. MVA; 2D images of the mitral valve were acquired using a parasternal short axis window, and planimetry was conducted. From the apical four-chamber window via the mitral valve, continuous-wave Doppler recordings were collected, and MVA was calculated using the formula 220/PHT [23]. Three cardiac cycles were recorded for each subject, and the findings were averaged. Before and after surgery, colour flow

Doppler is performed to rule out problems such as perforation, MR larger than II/IV, and atrial left-to-right shunt. Left ventricular systolic function: End systolic (LVESD) and end diastolic (LVEDD) diameters were determined; consequently, EF percent and FS percent were derived using the M-mode approach Three cardiac cycles were recorded for each subject, and the findings were averaged. Before and after surgery, colour flow Doppler is performed to rule out problems such as perforation, MR larger than II/IV, and atrial left-to-right shunt. Left ventricular systolic function: End systolic (LVESD) and end diastolic (LVEDD) diameters were determined; consequently, EF percent and FS percent were derived using the M-mode approach [24]. The basal and apical short-axis views and a long-axis plane were acquired using a B-mode and multi-frequency probe on a Vivid 9 ultrasound system (GE Vingmed Ultrasound, Horten, Norway) (MHZ 1.7-4). As anatomical indicators for the exact detection of short-axis levels throughout the cardiac cycle, the existence of the mitral valve with symmetric leaflet coaptation and the LV cavity without visible papillary muscles were used. The LV cross section was intended to be as nearly round as possible [25]. The velocity range for Tissue Doppler imaging (TDI) was modified to 20 cm/s to prevent aliasing. On a workstation equipped with EchoPAC, further offline analysis of STI data sets was conducted (GE Vingmed Ultrasound, version 9.0.1) [26].

To compute the STI-derived LV twist mechanics, parasternal short-axis pictures of the LV base and apex are acquired. Utilizing STI, the highest quality two-dimensional photos were selected. The endocardium was traced in an optimum frame, from which an area of interest was picked automatically for speckle tracking. As necessary, the area of interest was expanded to represent the transition from endocardium to epicardium in wall thickness. Using the approach of sum of absolute differences, the computer decided which stable objects were acceptable for tracking and then looked for them in the next frame [13]. The average values of apical and basal LV short-axis rotation and rotational velocity were used to calculate LV twist/rotation and its temporal derivative (Figure 1). During the isovolumic relaxation phase, the peak diastolic untwisting velocity of the left ventricle is measured in degrees per second.

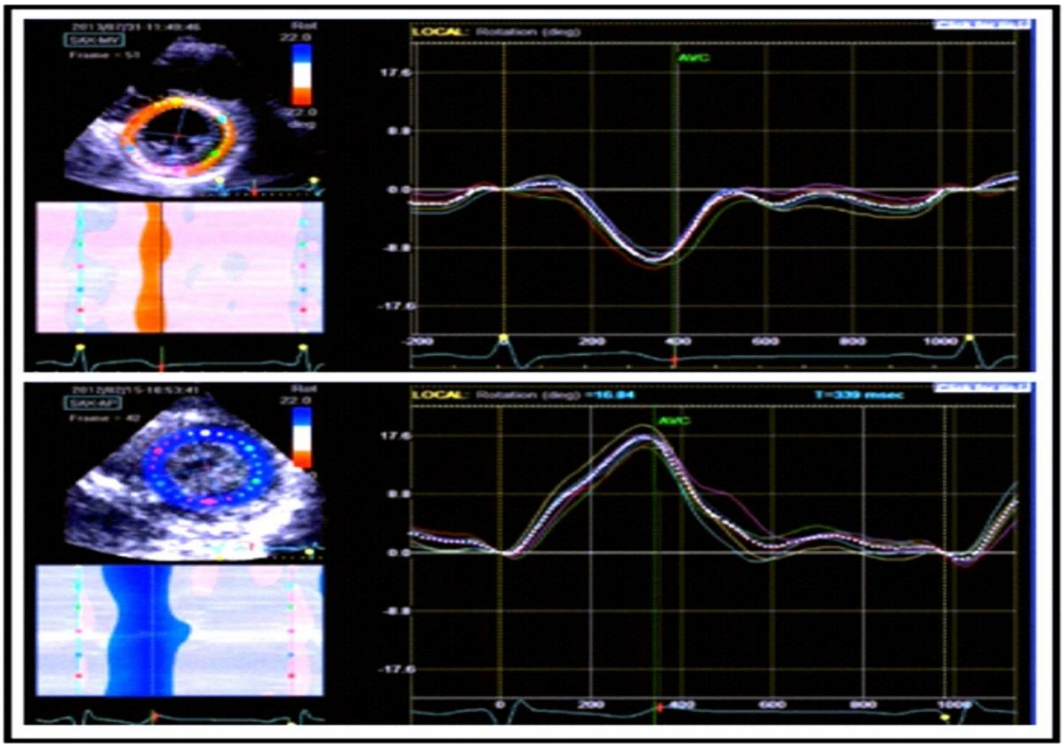

Figure (1): LV rotation at basal (top) and apical (bottom) levels during the cardiac cycle by STI [27]

PBMV: In one group, PBMV was performed using the antegrade double balloon approach, whereas the other used the Inoue balloon technique. The diameter of the mitral annulus controlled the size of the balloon (measured by echocardiography). The usual features of hemodynamics were noticed. Under local anaesthesia, BMV was performed, commencing with right-sided cardiac catheterization and pulmonary artery systolic pressure measurements (PASP). All antegrade methods started with a successful trans-septal catheterization and access to the left atrium through the appropriate part of the atrial septum to permit access to the mitral valve, followed by insertion of a 7 French Mullins-type dilator and sheath into the left atrium. In order to achieve systemic anticoagulation, 100 IU/kg of unfractionated heparin was then delivered. At the completion of the surgery, hues sway Doppler echocardiography was conducted to confirm successful balloon dilatation and rule out complications including perforation, larger than II/IV MR, and an atrial left-to-right shunt. The BMV success criteria include a 50 to 60% reduction in transmitral gradient. MVA exceeding 1.5 cm2. A decrease in left atrial pressure to less than 18 mmHg is deemed normal in the absence of complications [22]. All of the aforementioned criteria were used to assess the success of the treatment.

Statistical analysis

SPSS version v26 was used for statistical analysis (IBM Inc., Chicago, IL, USA). Using an unpaired Student's t-test, mean and standard deviation statistics for the two groups were produced (SD). If appropriate, qualitative variables were presented as frequency and percentage (percent) and analysed using Chi-square or Fisher's exact test. A two tailed P value < 0.05 was considered statistically significant.

Results

Comparison between group I and group II regarding demographic data and risk factors; there was no differences found between both groups. (Table 1)

Table 1: Comparison between group I and group II regarding (Demographic data and risk factors); age, gender, AF/NSR, HTN, DM and smoking

Demographic data		Group I	Group II	P-value
		No.= 30	No.= 30	
Age	Mean ± SD	31.63 ± 5.83	31.63 ± 5.34	1.000
	Range	21 – 48	23 – 45	
Gender	Female	21 (70.0%)	19 (63.3%)	0.584
	Male	9 (30.0%)	11 (36.7%)	
AF/NSR	AF	17 (56.7%)	17 (56.7%)	1.000
	NSR	13 (43.3%)	13 (43.3%)	
HTN	Negative	30 (100.0%)	30 (100.0%)	NA
	Positive	0 (0.0%)	0 (0.0%)	
DM	Negative	30 (100.0%)	30 (100.0%)	NA
	Positive	0 (0.0%)	0 (0.0%)	
Smoking	Negative	28 (93.3%)	27 (90.0%)	0.64
	Positive	2 (6.7%)	3 (10.0%)	

NSR, normal sinus rhythm; HTN, Hypertension; DM, Diabetes mellitus.

Regarding conventional echo data in group I; the MVA was highly significantly increased after BMV, while MPG and the estimated systolic pulmonary artery pressure (SPAP) were highly significantly decreased. (Table 2)

Table 2: Comparison between pre and post BMV, regarding conventional echo data in group I

Group I		Pre	Post	Test value	P-value
		No.= 30	No.= 30		
IVSD (mm)	Mean ± SD	9.20 ± 0.96	9.20 ± 0.96	NA	NA
	Range	8 – 11	8 – 11		
LVPW (mm)	Mean ± SD	8.53 ± 0.94	8.53 ± 0.94	NA	NA
	Range	7 – 11	7 – 11		
LVESD (mm)	Mean ± SD	25.47 ± 1.78	25.47 ± 1.78	NA	NA
	Range	23 – 30	23 – 30		
LVEDD (mm)	Mean ± SD	45.17 ± 2.51	45.17 ± 2.51	NA	NA
	Range	41 – 50	41 – 50		

EF (%)	Mean ± SD	56.13 ± 3.54	56.13 ± 3.54	NA	NA
	Range	50 – 62	50 – 62		
SCORE	Mean ± SD	7.73 ± 0.94	7.73 ± 0.94	NA	NA
	Range	6 – 9	6 – 9		
MVA ($cm^{2)}$	Mean ± SD	1.03 ± 0.19	2.04 ± 0.21	-33.544	0.000
	Range	0.7 – 1.4	1.7 – 2.4		
MPG (mmHg)	Mean ± SD	14.00 ± 2.98	4.33 ± 1.27	25.579	0.000
	Range	9 – 20	3 – 7		
LA (mm)	Mean ± SD	45.37 ± 2.50	45.37 ± 2.50	NA	NA
	Range	41 – 50	41 – 50		
SPAP (mmHg)	Mean ± SD	61.27 ± 6.09	25.30 ± 4.39	37.391	0.000
	Range	50 – 75	15 – 32		

Regarding conventional echo data in group II; MVA was highly significantly increased after BMV, meanwhile, the mean pressure gradient (MPG) and the estimated systolic pulmonary artery pressure (SPAP) were highly significantly decreased. (Table 3)

Table 3: Comparison between pre and post BMV regarding conventional echo data in group II

Group II		Pre	Post	P-value
		No.= 30	No.= 30	
IVSD	Mean ± SD	9.07 ± 0.83	8.97 ± 0.85	0.586
	Range	8 – 10	8 – 10	
LVPW	Mean ± SD	8.13 ± 0.73	8.37 ± 0.72	0.129
	Range	7 – 9	7 – 9	
LVESD	Mean ± SD	26.13 ± 1.46	26.10 ± 1.63	0.912
	Range	24 – 30	24 – 30	
LVEDD	Mean ± SD	44.83 ± 1.76	44.83 ± 1.76	NA
	Range	42 – 50	42 – 50	
EF	Mean ± SD	57.47 ± 2.64	57.63 ± 2.79	0.769
	Range	55 – 65	55 – 65	
SCORE	Mean ± SD	7.77 ± 0.86	7.77 ± 0.86	NA
	Range	6 – 9	6 – 9	
MVA	Mean ± SD	0.96 ± 0.17	1.99 ± 0.22	0.000
	Range	0.7 – 1.3	1.6 – 2.4	
MPG	Mean ± SD	14.87 ± 2.54	5.72 ± 1.22	0.000
	Range	11 – 20	5 – 9	
LA	Mean ± SD	45.33 ± 2.15	45.33 ± 2.15	NA
	Range	41 – 50	41 – 50	
SPAP	Mean ± SD	62.60 ± 5.80	26.30 ± 7.41	0.000
	Range	55 – 75	15 – 55	

IVSD: Inter-ventricular septum. LVPW: Left ventricle posterior wall. LVESD: Left ventricle end systolic diameter. LVEDD: Left ventricle end- diastolic diameter. EF: Ejection fraction. MVA: Mitral valve area. MPG: Mean pressure gradient. LA: Left atrium. SPAP: Systolic pulmonary artery pressure

Comparison between the two groups regarding MR pre and post BMV; MR pre or post BMV was insignificantly different between both groups. (Table 4)

Table 4: Comparison between group I and group II regarding mitral regurgitation (MR) pre and post BMV

Mitral regurgitation	Degree	Pre-valvuloplasty			Post-valvuloplasty		
		Group I	Group II	P	Group I	Group II	P
		No. (%)	No. (%)	**0.553**	No. (%)	No. (%)	**0.879**
	No	2(6.7%)	1 (3.3%)		1 (3.3%)	1 (3.3%)	
	Mild	28 (93.3%)	29 (96.7%)		20 (66.7%)	27 (90%)	
	Moderate	0 (0.0%)	0 (0.0%)		9 (30.3%)	2 (6.7%)	

Comparison between pre and post BMV regarding MR in both groups; MR was significantly increased after BMV in each group. (Table 5)

Table 5: Comparison between pre and post BMV regarding MR in both groups

Mitral regurgitation	Degree	Group I			Group II		
		pre	post	P	pre	post	P
		No. (%)	No. (%)	0.013	No.(%)	No.(%)	0.001
	No	2 (6.7%)	1 (3.3%)		1 (3.3)	1 (3.3%)	
	Mild	28 (93.3%)	20 (66.7%)		29 (96.7%)	17 (56.7)	
	Moderate	0 (0.0%)	9 (30%)		0 (0.0%)	12 (40%)	
	Severe	0 (0.0%)	0 (0.0%)		0(0.0%)	0 (0.0%)	

Comparison between pre and post BMV regarding twist and untwist in each group; apical rotation, basal rotation, twist and untwist were highly significantly decreased after BMV. (Table 6)

Table 6: Comparison between pre and post BMV regarding twist and untwist in both groups

Item		Group I			Group II		
		Pre	Post	P	Pre	Post	P
Apical rotation(o)	Mean ± SD Range	5.70 ± 1.13 4 – 8	3.95 ± 0.71 2.3 – 5	0.000	5.26 ± 0.64 3.5 – 6.3	3.74 ± 0.65 2.4 – 5.2	0.000
Basal rotation(o)	Mean ± SD Range	-1.66 ± 0.63 -2.9 – -0.6	-1.51 ± 0.52 -2.5 – -1	0.033	-2.07 ± 0.89 -4 – -1.26	-1.73 ± 0.66 -3 – -1	0.000
Twist(o)	Mean ± SD Range	7.41 ± 0.83 6.26 – 9	5.33 ± 0.51 4.2 – 6.8	0.000	7.84 ± 1.06 5.7 – 9.3	5.62 ± 1.06 4 – 7.2	0.000
Untwist(o)	Mean ± SD Range	59.27 ± 18.79 -97 – -33	-45.80 ± 14.88 -78 – -25	0.000	-67.00 ± 16.77 -97 – -35	-48.07 ± 18.55 -82 – -28	0.000

Apical rotation, basal rotation, twist and untwist were insignificant between the studied groups. (Table 7)

Table 7: Comparison between group I and group II regarding twist and untwist pre and post balloon mitral valvuloplasty

Item		Pre-valvuloplasty			Post-valvuloplasty		
		Group I	Group II	P	Group I	Group II	P
Apical rotation	Mean ± SD Range	5.70 ± 1.13 4 – 8	5.26 ± 0.64 3.5 – 6.3	0.067	3.95 ± 0.71 2.3 – 5	3.74 ± 0.65 2.4 – 5.2	0.241
Basal rotation	Mean ± SD Range	-1.66 ± 0.63 -2.9 – -0.6	-2.07 ± 0.89 -4 – -1.26	0.073	-1.51 ± 0.52 -2.5 – -1	-1.73 ± 0.66 -3 – -1	0.166
Twist	Mean ± SD Range	7.41 ± 0.83 6.26 – 9	7.84 ± 1.06 5.7 – 9.3	0.084	5.33 ± 0.51 4.2 – 6.8	5.62 ± 1.06 4 – 7.2	0.194
Untwist	Mean ± SD Range	-59.27± 18.79 -97 – -33	-67.00 ± 16.77 -97 – -35	0.098	-45.80±14.88 -78 – -25	-48.07 ± 18.55 -82 – -28	0.604

New onset arrhythmias was insignificant between both studied groups. (Table 8)

Table 8: Comparison between group I (no. =30) and group II (no. =30) regarding new onset arrhythmias after BMV

Arrhythmias	Group I		Group II		P-value
	No	%	No	%	
Premature atrial beats	5	16.7%	8	26.7%	0.709
Premature ventricular beats	1	3.3%	5	16.7%	
New onset atrial fibrillation	1	3.3%	2	6.7%	
Runs of ventricular tachycardia	0	0.0%	1	3.3%	

Discussion

PMBV is now viewed as a preferred option to open mitral surgery in patients with moderate to severe symptomatic MS, mitral valve area of 1.5 cm2, NYHA functional class II to IV, favourable valve architecture without commissural calcification, no or mild MR, and no LA thrombus. Notable is the expansion of PMBV indications to include less desirable circumstances, such as inadequate valve construction, and as a palliative treatment for elderly patients who are poor surgical candidates [28].

The Inoue single-balloon (SB) technique differs from the double-balloon technique in a number of significant ways; the dilating shape achieved in the Inoue balloon is circular and shows higher stress in the central portion of the leaflets and at the commissures as a result of a mismatch between the round shape of the SB and the oval mitral orifice. While the elliptical dilating shape formed by the double balloon ensures commissural splitting, even when a substantial force is required to break the commissure welds, the shape of the single balloon shows less uniform stress distribution [29].

I- Regarding conventional echocardiographic parameters, in both groups, before and immediately after balloon mitral valvuloplasty:

In this study there were no significant differences detected between both groups either before or after balloon valvuloplasty as regard conventional echocardiographic parameters.

In each group; our study did not show any significant differences as regard left ventricular dimensions and function, mitral valve score and LA dimension. Expectedly, MVA was significantly increased post valvuloplasty, while, MPG and PASP were significantly decreased. Pamir et al. [30], who studied the effect of PBMV on left ventricular filling and EF, came to similar conclusions. They evaluated LV filling and EF in 23 MS patients before to and after a successful PBMV that was uncomplicated by significant MR and arrhythmia during left ventriculography. After PBMV, the mean mitral valve gradient (MVG) fell to 6.93.2 mmHg while the mean mitral valve area (MVA) rose to 2.20.3 cm2 (P0.01). Before PBMV, EF was 61.89.3 percent; after PBMV, it was 61.87.6 percent (P>0.05). In addition, there was no increase in the LV end diastolic volume index (89.927.7 cm3/m2 before to PBMV and 84.620.9 cm3/m2 after PBMV; P>0.05). The diastolic function of the LV is reduced in MS patients, whereas PBMV has no initial effect on the LV EF.

Using a modified Bernoulli equation, Georgeson et al. [31], who explored the impact of percutaneous balloon valvuloplasty on pulmonary hypertension, assessed the RVSP in patients with TR. RVSP Doppler and catheterization had a significant correlation. Doppler tests indicated that the right ventricle's systolic pressure was 56.4 mm Hg before to valvuloplasty and 48.4 mm Hg immediately after. This may be because the improvement of myocardial performance index (measure of global LV function) takes further time, since our study case analysis was done during the first twenty-four hours after therapy.

Mitral regurgitation: Despite the increased severity of mitral regurgitation in both groups post balloon mitral valvuloplasty, there was no significant difference found between them. Palacios et al. [32] reported that although approximately half of patients undergoing balloon mitral valvotomy exhibit a small increase in MR, severe MR is relatively rare, with a frequency ranging from 1.4 to 9.4%.
Our data are consistent with that of Vahanian et al.[33] who documented that; after BMV, severe MR was noted in 4% of patients with more calcified valves or extensive subvalvular disease.

Similar results to our study were reached by Farooq et al. [34] who documented that; post-procedure severe MR is a significant and frequent complication. Rate of post procedure sever MR are similar for PMBV via Inoue balloon and multi- track balloon. Both methods are equally effective with equal success rate. This was again in agreement with the data obtained by Serra et al. [35] who stated that; MR developed or increased in severity in 38% of patients. This increase was (1degree) in 85% of cases.

II- Regarding left ventricular rotational deformation imaging (apical and basal rotations, twist and untwist) pre and post-balloon mitral valvuloplasty in both groups:

In this study apical and basal rotations, twist and untwist values decreased post valvuloplasty in both groups, but they did not reach statistical significance. Multiple exhaustive investigations have shown that LV twist mechanics are susceptible to changes in LV loading circumstances; hence, LV twist mechanics cannot be regarded as load-independent markers of contractility. Gibbons Kroeker et al. [36] revealed that LV apical rotation is affected by changes in loading conditions and concluded, "LV twist is mostly reliant on volume." Dong et al. [37] demonstrated that differences in preload or afterload have an effect on the twist mechanics of LV structures. Specifically, they proved that an increase or reduction in preload resulted to an increase or decrease, respectively, in LV twist. Burns A.T. et al. and Weiner R.B. et al. [38, 39] studies were done on normal hearts, but our cases are complicated by RHD, including scarred mitral valve apparatus, abnormal left-to-right ventricular communication, and the risk of myocardial disease.

Our results are consistent with those of Rifaie et al. [40], who examined the immediate effect of BMV on the mechanics of the left ventricular twist. They analysed 39 BMV candidates. Before and immediately after BMV, speckle tracking echocardiography (STE) was used to evaluate the twist mechanics of the heart (basal rotation, apical rotation, and torsion). Using STE as a control group, 15 healthy persons' twist mechanics were also evaluated. There were 28 women with a mean age of 30.4.7.2 and a mean BMI of 24.7.3.1. (72 percent). All twist mechanics, including apical rotation and torsion, were lower post-BMV compared to pre-BMV, perhaps due to the inability of the LV to adjust to the sudden increase in preload.

Samaan et al. [41] used the Cardiac Magnetic Resonance Imaging to evaluate the impact of effective BMV on LV rotational deformation in patients with isolated rheumatic MS is challenged. Six months after BMV, MS patients saw a substantial reduction in base-apex LV torsion, followed by a considerable increase at one year. A same pattern of recovery was seen for base mid LV torsion, followed by a significant improvement in LVEF. As the preload rapidly rose after valvuloplasty, it was predicted that the base-apex LV torsion would significantly improve or rise, but this was not the case in our research. This may be attributable to the incapacity of the left ventricle to adjust to the abrupt increase in preload as a result of myocardial rheumatic involvement; hence, a long-term follow-up is essential to re-evaluate any improvement in LV torsion.

III- Regarding arrhythmias:
Although the incidence of arrhythmias, namely, premature atrial and ventricular beats, new onset atrial fibrillation and runs of non-sustained ventricular tachycardia, increased in both groups post valvuloplasty, this finding did not reach statistical significance between them. There is some similarity between our results and those of Nawaz et al. [42] who studied 300 patients with mean age of 26.26 ± 11.54 years, of which 78 (26%) were males. New onset arrhythmias 24 (8%), tachy-arrhythmia 16 (5.3%) and brady-arrhythmia 8 (2.6%).
Limitations: The risk assessment and differentiation between the two treatments may have been less exact and clear due to the limited sample size. In addition, since this study focused on rheumatic MS in younger individuals, its results may not apply to older individuals. Moreover, the group was varied, since it comprised

people with AF and NSR, who may have distinct effects on rotation. The lack of follow-up is a serious deficiency. The lack of a direct comparison with the gold standard noninvasive method for evaluating LV mechanics (i.e., CMR) is one of the most significant limitations of our work, as STE-derived LV rotation relies on good image quality and attempts to follow three-dimensional motion with a two-dimensional image. Unlike cardiac magnetic resonance, the LV slices may be picked with precision.

Recommendations**:** It is better that the patients should be homogenized according to age and the type of rhythm. Future studies dealing with a large number of patients are needed to verify the above results and to make the risk assessment more accurate and the difference of successful outcome between the 2 techniques clearer, in addition to throw more light into this important issue. Twist and untwist measurement using 2D based speckle tracking should be considered as an essential part of routine echocardiography. In the future, much effort should be exerted to solve the technical problems and pitfalls of twist and untwist imaging.

Conclusions: LVEF does not improve acutely after BMV. Left ventricular twist and untwist mechanics decrease after PBMV, but no difference is documented between the two techniques. MR and new onset arrhythmias are documented complications of PBMV in both techniques; despite the increased severity of MR in both techniques after BMV, there was no significant difference found between both techniques of PBMV.

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Conflict of Interest: Nil

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