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Right Ventricular Function after isolated Mitral valve Replacement in Rheumatic Mitral Stenosis with Pulmonary Hypertension

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ABSTRACT

Background: Right ventricular global function (RVF) of the high pressure right ventricle in mitral stenosis patient's post Mitral Valve Replacement (MVR) had not been well-defined. *Objectives:* We evaluated the MVR effects on RVF in immediate and mid-term post-operative periods for mitral stenosis status *Methods:* A prospective observational study was conducted on 80 patients with mitral

stenosis. RVF evaluated pre, immediately post, 3 and 6 months Post MVR by both conventional and tissue Doppler echocardiography imaging process. Where, evaluated patients were divided into 2 groups (Group (I) PAP>40 mm Hg, n: 26; Group (II) PAP<40 mm Hg, n: 54) according to systolic pulmonary artery pressure which was recorded through using echocardiography prior to MVR. *Results:* After MVR mean gradient, PASP and LA showed significant decrease. However, this PASP significance was decreased at 3 to 6 months follow up (Mean SD from 42.67±11.3 to 47.36±13.69). Significant post MVR increase in TAPSE, RVFAC%, E Peak in addition to significant decrease in RA maximal volume, deceleration time, A peak and MPI indicating improved RV function.6 months follow up showed decreased significance of TAPSE, RA maximum volume and MPI. However, the significance was lost in RVFAC%, A and E peak. Similar results were obtained on comparing group (II) with overall group. *Conclusion*: RVF improved significantly after MVR during the immediate postoperative and short term, those positive effects decreased with patients developing pulmonary hypertension (group II) for subsequent mid-term follow-ups. Denoting how important is to intervene in those patients before development of pulmonary hypertension for a better RV response.

Keywords: Rheumatic mitral valve stenosis, PASP, pulmonary Hypertension, Myocardial Dysfunction.

1. INTRODUCTION

Rheumatic heart diseases still remain a main health problem in many developing countries and sequel of rheumatic fever and represent 30% of patients with rheumatic fever (Kormos et al., 2010). In spite of RF and RHD were rare in several countries, it still a major health problems in children and young in less developed regions (Karthikeyan and Mayosi, 2009). Rheumatic heart was found with many degrees of pancarditis. Involvement of mitral leaflets which could led to mitral regurgitation or stenosis and eventually can lead to heart failure. Mitral repair or replacement is therefore recommended before left ventricular dysfunction develops (Nishimura et al., 2014). Annual deaths numbers from RHD in 2000 were 332000 (Organization, 2004). Valvular Heart Disease (VHD) was common etiology of pulmonary hypertension, with subsequent RV dysfunction that may evolve from several methods such direct myocardial affection by the rheumatic pathology or secondary to hemodynamic alterations due to pulmonary vascular change and inducing RV overload. PH is a marker of poor outcome in VHD. Presence and severity of pulmonary hypertension assessments have very important roles in stratification risk and VHD management (Borer et al., 1991, Humbert et al., 2012).

Easy fatigability and decreased exercise capacity are commonly found in MS patients. Right ventricular function is substantial in determining the symptoms, exercise capacity, prognosis and survival (Tayyareci et al., 2008, Yildirimturk et al., 2012). The etiology of the RV dysfunction may be from direct myocardial affection through the rheumatic process or subsequent to hemodynamic changes resulting from pulmonary vascular alteration, which eventually will lead to an overloaded and failed RV (Borer et al., 1991, Iskandrian et al., 1984).

Many studies have investigated the relation between RV function and rheumatic MS(Burger et al., 1997, Özdemir et al., 2003); however, studies over the effect of MVR on RV function in rheumatic MS is very limited and rare.

2. PATIENTS AND METHODS

Prospective observational case series, conducted From October 2018 to April 2020, where the information was gathered from the eligible patients (Preoperative, immediate, three and six month's postoperative Echocardiographic assessment) was entered into a data sheet containing the variables of interest that will be analyzed. This study does not alter the patient's treatment and follow up by any means.

The study included a total of 80 patients (presented to our department who meet the inclusion and exclusion criteria during the period of study) 33.8% males and 66.3% females with average age of 42.89 years (±12.06 SD), fulfilling the inclusion and exclusion criteria undergoing Mitral valve replacement. Indication of MVR were: Sever symptomatic patients contraindicated to PTMC, with favorable anatomical and clinical characteristics, severe asymptomatic patient with positive exercise testing with unfavorable characteristics for PTMC, severe (MVA > 1.5 cm) with Wilkins score +8, AF, thromboembolic manifestation. Cases were assigned into 2 groups as follow: (I): 26 cases with PASP <40mmhg and (II): 54 cases with PASP >40mmhg.

Inclusion criteria: No age limitation, Isolated mitral valve stenosis and Good LV function (EF >50%).

Exclusion criteria: Concomitant Aortic valve lesion, concomitant CABG, poor LV function (Low EF< 50%), severe TR, other causes of pulmonary hypertension i.e.: (chronic obstructive or restrictive pulmonary disease, connective tissue disease and chronic thromboembolism), emergency operations.

Patient Characteristics: Age (years), sex (%), NYHA classification and Right sided heart failure (clinically i.e.: LL edema, etc.)

Echocardiographic study: 2D and pulse-wave Doppler echocardiographic were done in left lateral decubitus position with standard views (parasternal long and short axis, apical 4 chamber views) and in supine position for sub xiphoid view**.** Mitral valve lesion type and severity, LV assessment (EF%, LVEDD, LVESD), Pulmonary artery systolic pressure, Tricuspid regurge and degree, RV & RA assessment: RA size, TAPSE(Tricuspid annulus plane systolic excursion), Doppler imaging issue over tricuspid annulus (SV, AV and EV) and Myocardial performance index (MPI).

Intraoperative Data: Total bypass & Cross clamp time and Technique of MVR (MV preservation or not), size of valve.

Postoperative variables: Morbidity, Mortality**,** Hospital stay and discharge

MVR: conventional midline sternotomy. Aortobicaval cannulation (selective or non-selective).Cardiac arrest through antegrade cold crystalloid cardioplegia.MVR (prosthetic valves) through left atriotomy in normal fashion.

Follow up: All patients underwent echocardiographic evaluation at immediate, 3 and 6 months postoperatively.

Statistical analysis: Data analysis using SPSS/ 20.0**.** Qualitative information's were described as number and percent. Kolmogorov-Smirnov test to verify normal distribution for Quantitative information's, $P<0.05$.

3. RESULTS

Among studied cases there were 20 (25%) Class IINYHA, 56 (70%) class III (5%) Class IV, According to the degree of pulmonary artery pressure there were 26 (32.5%) with PASP (< 40 mmhg) and 54 (67.5%) with PASP (> 40 mmhg), and according to degree of tricuspid regurge there were 13 (16.3%) with mild, 20 (25%) with moderate and 47 (58.8%) with trace TR.

Table 1: Studied cases distribution according to clinical information (n = 80)

Clinical data	n	%
NYHA functional class		
Class II	20	25.0
Class III	56	70.0
Class IV	4	5.0
Degree of pulmonary hypertension		
Mild	26	32.5
Severe	54	67.5
Degree of tricuspid REGURE		
Trace	47	58.75
Mild	13	16.3
Moderate	20	25.0

The mean Aortic clamping was 52.15 (±12.97 SD) with range (26.5-73.1), the mean CPB was 68.18 minutes (±15.73 SD) with range (39.2-97.9), the mean ventilation duration was 10.64 hours (±5.86 SD) with range (1.5-20), the mean stay in ICU was 2.16 days (±0.97 SD) with range (0.4-4.2), the mean hospital stay was 8.13 days (±3.3 SD) with range (4-20).No mortality(0%)during the operation.

Table 2: Studied cases distribution according to different parameters (n = 80)

	n	%
Aortic clamping (min)		
Min. – Max.	26.50 – 73.10	
Mean ± SD.	52.15 ± 12.97	
Median (IQR)	55.10 (41.10 – 62.75)	
CPB (min)		

Min. – Max.	39.20 – 97.90	
Mean ± SD.	68.18 ± 15.73	
Median (IQR)	69.20 (55.50 – 81.35)	
Ventilation (hours)		
Min. – Max.	1.50 – 20.0	
Mean ± SD.	10.64 ± 5.86	
Median (IQR)	10.50 (5.50 – 16.50)	
Stay in ICU (Days)		
Min. – Max.	0.40 – 4.20	
Mean ± SD.	2.16 ± 0.97	
Median (IQR)	2.10 (1.40 – 3.0)	
Hospital stay (Days)		
Min. – Max.	4.0 – 20.0	
Mean ± SD.	8.13 ± 3.30	
Median (IQR)	8.0 (5.0 – 10.0)	
Operative mortality		
No	80	100.0
Yes	0	0.0

As shown in table (3) there were high statistically significant differences between the different periods of study regarding Mean GR, LA and LVEF% ; however, no statistically significant difference regarding LVDD.

Table 3: Comparison between the different echocardiographic values according to the different period of study (n = 80)

	Preoperative	**Post-operative**	**3 months after operation**	**6 months after operation**	**F**	**P**
LVDD (mm)						
Min. – Max.	41.10 – 56.40	39.30 – 55.30	40.30 – 52.80	41.10 – 51.10	1.736	0.159
Mean ± SD.	48.41 ± 4.16	47.99 ± 4.12	47.62 ± 4.40	49.09 ± 4.43		
Median (IQR)	48.65(45.25–51.33)	47.1 (44.38–51.53)	46.9(44.20–50.18)	49.6(45.18–52.68)		
p_0		0.522	0.245	0.245		
LVSD (mm)						
Min. – Max.	31.70 – 40.80	30.10 – 39.60	30.60 – 36.30	31.60 – 36.30	27.974*	<0.001*
Mean ± SD.	36.38 ± 2.60	34.49 ± 2.57	33.47 ± 1.68	34.16 ± 1.24		
Median (IQR)	36.25(34.55–38.70)	34.25(32.50–36.13)	33.55(31.88–34.75)	34.2(33.28–35.23)		
p_0		<0.001*	<0.001*	<0.001*		
Mean GR (mm Hg)						
Min. – Max.	8.10 – 17.0	2.20 – 6.0	2.10 – 5.90	2.20 – 5.90	566.128*	<0.001*
Mean ± SD.	12.21 ± 2.71	5.25 ± 0.68	5.03 ± 0.70	5.07 ± 0.70		
Median (IQR)	11.70(9.80–14.55)	5.40(5.15–5.60)	5.20(4.90–5.40)	5.20(4.90–5.45)		
p_0		<0.001*	<0.001*	<0.001*		
LA (mm)						
Min. – Max.	42.0 – 56.80	40.10 – 55.80	38.20 – 55.20	38.10 – 55.10	F= 139.370*	<0.001*
Mean ± SD.	48.74 ± 4.32	47.77 ± 4.25	46.87 ± 4.33	46.30 ± 4.34		
Median (IQR)	48.90(44.50–51.75)	48.45(44.0–50.55)	47.40(42.75–49.80)	46.80(42.50–49.0)		
p_0		<0.001*	<0.001*	<0.001*		
LVEF%						
Min. – Max.	50.0 – 70.0	55.0 – 70.0	54.0 – 70.0	53.0 – 70.0	63.821*	<0.001*
Mean ± SD.	55.59 ± 6.88	63.50 ± 4.87	63.08 ± 4.97	62.13 ± 4.97		
Median (IQR)	55.0(50.0–60.0)	64.0(59.0–68.0)	63.0(59.0–68.0)	62.0(58.50–67.0)		
p_0		<0.001*	<0.001*	<0.001*		

High significant differences among different variables in the form of increased TAPSE, RVFAC% and E peak. And decreased PASP, RA maximal volume, deceleration time, A peak and MPI. It is noted that PASP, TAPSE, RA maximum volume and MPI showed a decrease in this significance at 6 months follow up; however, the significance of RVFAC%, A and E Peak velocities were lost in the 6 months follow up(Table 4).

Table 4: Comparison between the different echocardiographic values according to the different period of study (n = 80)

	Preoperative	**Post-operative**	**3 months after operation**	**6 months after operation**	**Test of Sig.**	**P**
PASP (mm Hg)						
Min. – Max.	25.0 – 106.0	25.0 – 70.0	23.0 – 66.0	24.0 – 75.0	16.035*	<0.001*
Mean ± SD.	60.68 ± 24.30	51.01 ± 16.08	42.67 ± 11.31	47.36 ± 13.69		
Median (IQR)	60.0(36.0–78.50)	56.5 (33.75–66.0)	41.50(34.0–52.50)	48.0(35.0–59.50)		
p_0		0.003*	<0.001*	<0.001*		
RVFAC (%)						
Min. – Max.	35.0 – 41.0	36.0 – 45.0	35.20 – 44.90	32.60 – 44.0	F= 144.854*	<0.001*
Mean ± SD.	38.22 ± 1.84	40.71 ± 2.36	39.79 ± 2.38	38.35 ± 2.63		
Median (IQR)	38.25(36.50–39.80)	40.60(38.80–42.45)	39.80(37.90–41.05)	38.20(36.50–40.30)		
p_0		<0.001*	<0.001*	1.000		
TAPSE (mm)						
Min. – Max.	12.0 – 23.70	13.50 – 24.80	13.60 – 24.80	13.20 – 24.80	F= 5.443*	<0.001*
Mean ± SD.	17.42 ± 3.01	19.43 ± 3.33	18.89 ± 3.36	18.52 ± 3.32		
Median (IQR)	17.05(16.30–19.05)	19.10(16.30–22.15)	19.05(16.0–22.10)	18.65(15.75–21.85)		
p_0		<0.001*	0.004*	0.030*		
TR jet area/RAA						
Min. – Max.	0.07 – 0.43	0.05 – 0.40	0.05 – 0.40	0.05 – 0.43	Fr= 203.707	<0.001*
Mean ± SD.	0.25 ± 0.10	0.21 ± 0.07	0.12 ± 0.07	0.13 ± 0.07		
Median (IQR)	0.26(0.17–0.34)	0.05(0.05–0.10)	0.06(0.05–0.11)	0.08(0.07–0.12)		
p_0		<0.001*	<0.001*	<0.001*		
RA maximum volume (mL)						
Min. – Max.	30.20 – 41.70	29.0 – 41.10	28.80 – 41.0	29.10 – 42.10	164.838*	<0.001*
Mean ± SD.	36.07 ± 3.31	35.02 ± 3.31	34.78 ± 3.31	35.75 ± 3.44		
Median (IQR)	36.85(33.25–38.85)	35.25(32.50–38.15)	35.05(32.20–37.70)	35.60(33.10–38.75)		
p_0		<0.001*	<0.001*	0.004*		
	Preoperative	**Post-operative**	**3 months after operation**	**6 months after operation**	**F**	**P**
A peak (cm/s)						
Min. – Max.	40.20 – 49.90	35.50 – 49.0	38.80 – 50.70	39.10 – 51.40	116.076*	<0.001*
Mean ± SD.	45.26 ± 3.13	42.40 ± 3.45	44.27 ± 3.27	44.73 ± 3.31		
Median (IQR)	44.75(42.55–48.50)	42.50(39.90–45.10)	44.80(41.30–46.90)	45.05(41.65–47.60)		
p_0		<0.001*	<0.001*	0.071		
E peak (cm/s)						
Min. – Max.	35.10 – 54.90	37.50 – 61.50	33.40 – 59.30	33.0 – 58.90	F= 90.840*	<0.001*
Mean ± SD.	45.49 ± 5.63	49.38 ± 5.89	46.60 ± 6.21	46.12 ± 6.23		
Median (IQR)	46.60(40.50–49.95)	50.10(44.30–54.0)	46.30(41.15–51.85)	45.85(40.45–51.25)		
p_0		<0.001*	0.009*	0.419		
Myocardial performance index						
Min. – Max.	0.42 – 0.59	0.40 – 0.60	0.40 – 0.61	0.40 – 0.62	25.706*	<0.001*
Mean ± SD.	0.50 ± 0.05	0.43 ± 0.05	0.46 ± 0.05	0.48 ± 0.06		
Median (IQR)	0.50(0.46–0.54)	0.50(0.40–0.50)	0.50(0.41–0.51)	0.51(0.42–0.53)		
p_0		<0.001*	<0.001*	0.023*		

Systolic velocity (cm/s)						
Min. – Max.	9.0 – 17.0	9.70 – 19.80	8.90 – 19.40	8.10 – 19.20	F= 6.969*	<0.001*
Mean ± SD.	13.04 ± 2.26	14.79 ± 2.39	14.02 ± 2.36	13.55 ± 2.38		
Median (IQR)	12.85(11.35–14.95)	14.20(12.50–16.30)	13.50(11.70–15.35)	13.30(11.40–15.15)		
p_0		<0.001*	0.008*	0.167		
Early diastolic velocity (cm/s)						
Min. – Max.	8.0 – 14.0	8.80 – 16.90	7.60 – 15.90	7.20 – 15.90	F= 102.734*	<0.001*
Mean ± SD.	11.11 ± 1.73	12.68 ± 1.99	11.97 ± 2.07	11.83 ± 2.07		
Median (IQR)	11.20(9.50–12.30)	12.60(11.20–14.30)	12.15(10.50–13.60)	11.95(10.30–13.35)		
p_0		<0.001*	<0.001*	<0.001*		
Late diastolic velocity (cm/s)						
Min. – Max.	10.0 – 16.80	8.50 – 16.30	9.0 – 16.40	8.60 – 16.40	F= 9.628*	<0.001*
Mean ± SD.	13.09 ± 1.78	11.78 ± 1.71	12.08 ± 1.75	11.98 ± 1.72		
Median (IQR)	13.05(11.70–14.50)	12.30(10.90–13.60)	12.55(11.35–13.95)	12.50(10.95–13.85)		
p_0		<0.001*	<0.001*	<0.001*		

On subgrouping analysis, as shown in table (5) it was found that group II mimics the overall group regarding initial improvement and subsequent decline in RV Function. Meanwhile, group I showed a sustained improvement during the 6 months follows up evidenced by a significant increased TAPSE, SV, EV, IVV and IVA with decreased AV and MPI.

Table 5: Comparison between the different echocardiographic values according to the different period of study in both groups (n = 80)

		Preoperative	**Post-operative**	**3 months after operation**	**6 months after operation**	**F**	**P**
PASP (mm Hg)	**Group I (n = 26)**	32.46 ± 4.37	31.0 ± 3.35	31.0 ± 4.45	31.73 ± 4.39	0.732	0.535
	p_0						
	Group II (n = 54)	74.26 ± 17.10	59.24 ±9.27	48.35 ±8.73	54.89 ±9.64	47.752*	<0.001*
	p_0		<0.001*	<0.001*	<0.001*		
MPI	**Group I (n = 26)**	0.48 ± 0.05	0.41 ± 0.6	0.42 ± 0.06	0.42 ± 0.06	8.015*	<0.001*
	p_0		<0.001*	0.002*	0.001*		
	Group II (n = 54)	0.49 ± 0.05	0.42 ± 0.05	0.46 ± 0.05	0.48 ± 0.06	18.648*	<0.001*
	p_0		<0.001*	0.002*	0.349		
TAPSE	**Group I (n = 26)**	17.86 ± 3.11	20.69 ± 3.12	20.26 ± 3.12	19.85 ± 3.09	4.208*	0.008*
	p_0		0.002*	0.008*	0.024*		
	Group II (n = 54)	16.52 ± 2.81	18.90 ± 3.39	18.12 ± 3.37	17.52 ± 3.34	5.171*	0.002*
	p_0		<0.001*	0.008*	0.095*		
		Preoperative	**Post-operative**	**3 months after operation**	**6 months after operation**	**F**	**P**
SV	**Group I (n = 26)**	12.53 ± 1.65	14.52 ± 1.65	14.30 ± 1.65	13.68 ± 1.62	7.672*	<0.001*
	p_0		<0.001*	<0.001*	0.014*		
	Group II (n = 54)	13.29 ± 2.47	14.92 ± 2.66	13.89 ± 2.63	13.49 ± 2.67	4.180*	0.007*
	p_0		0.0013*	0.224	0.685		
EV	**Group I (n = 26)**	10.63 ± 1.64	12.13 ± 1.58	11.54 ± 1.67	11.53 ± 1.69	3.678*	0.014*
	p_0		0.002*	0.053	0.056		
	Group II (n = 54)	11.34 ± 1.73	12.95 ± 2.12	12.17 ± 2.22	11.97 ± 2.23	5.472*	0.0012*
	p_0		<0.001*	0.032*	0.104		
AV	**Group I (n = 26)**	14.04 ± 1.73	11.58 ± 1.68	11.53 ± 1.67	11.80 ± 1.66	13.345*	<0.001*
	p_0		<0.001*	<0.001*	<0.001*		
	Group II (n = 54)	12.64 ± 1.62	11.88 ± 1.72	12.35 ± 1.72	12.06 ± 1.75	2.072	0.105
	p_0		0.02*	0.369	0.076		
IVV	**Group I (n = 26)**	0.11 ± 0.03	0.11 ± 0.03	0.12 ± 0.03	0.12 ± 0.03	0.010	0.998
	p_0		1	0.235	0.235		
	Group II (n = 54)	0.11 ± 0.03	0.12 ± 0.04	0.12 ± 0.04	0.11 ± 0.04	1.263	0.288

	p0		0.144	0.144	0.999		
IVA	**Group I (n = 26)**	2.26 ± 0.24	2.31 ± 0.27	2.35 ± 0.25	2.38 ± 0.24	1.120	0.344
	p0		0.483	0.191	0.077		
	Group II (n = 54)	2.25 ± 0.4	2.22 ± 0.41	2.24 ± 0.41	2.29 ± 0.39	0.288	0.833
	p0		0.701	0.898	0.599		

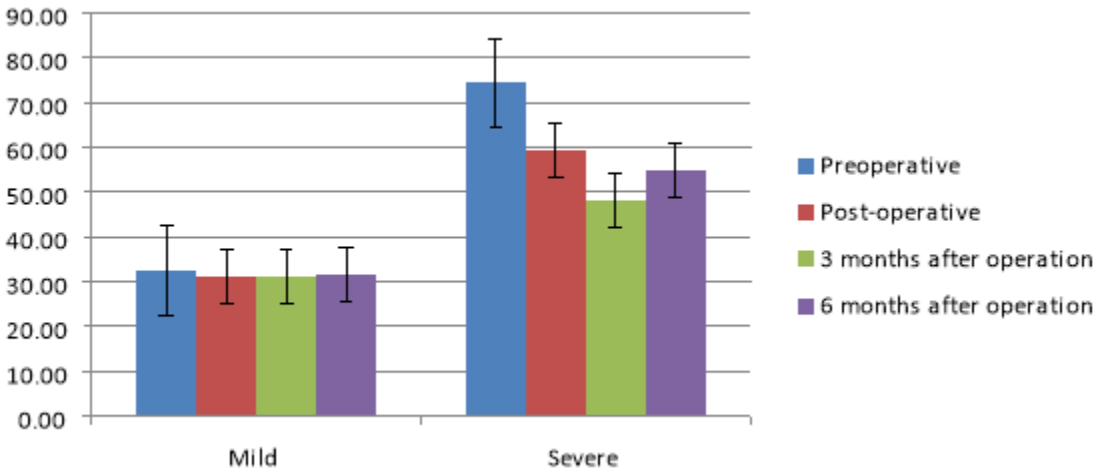

Diagram 1 Comparison between PASP at the different period of study in both groups (n = 80)

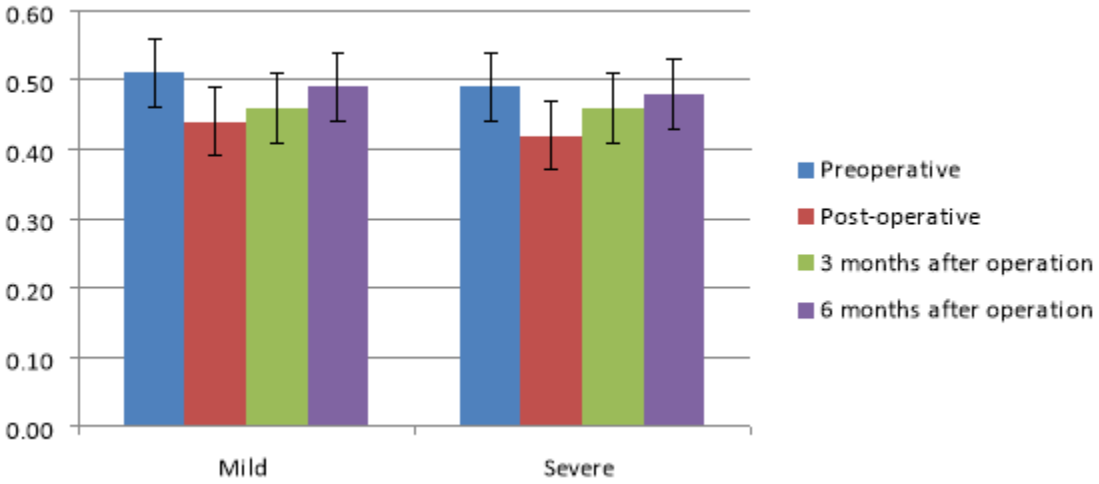

Diagram 2 Comparison between MPI at the different period of study in both groups (n = 80)

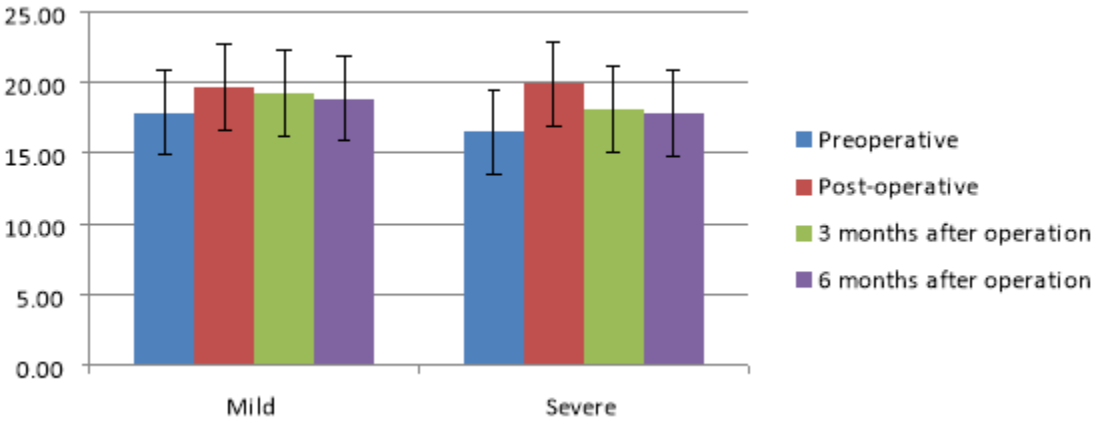

Diagram 3 Comparison between TAPSE at the different period of study in both groups (n = 80)

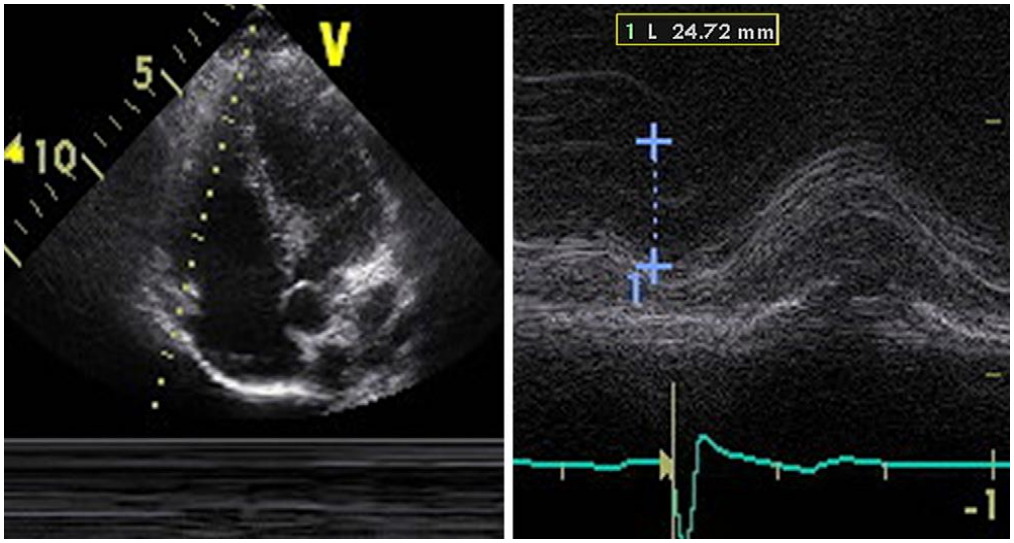

Figure 1 Measurement of TAPSE by applying the curser over the lateral aspect of tricuspid annulus using M-Mode

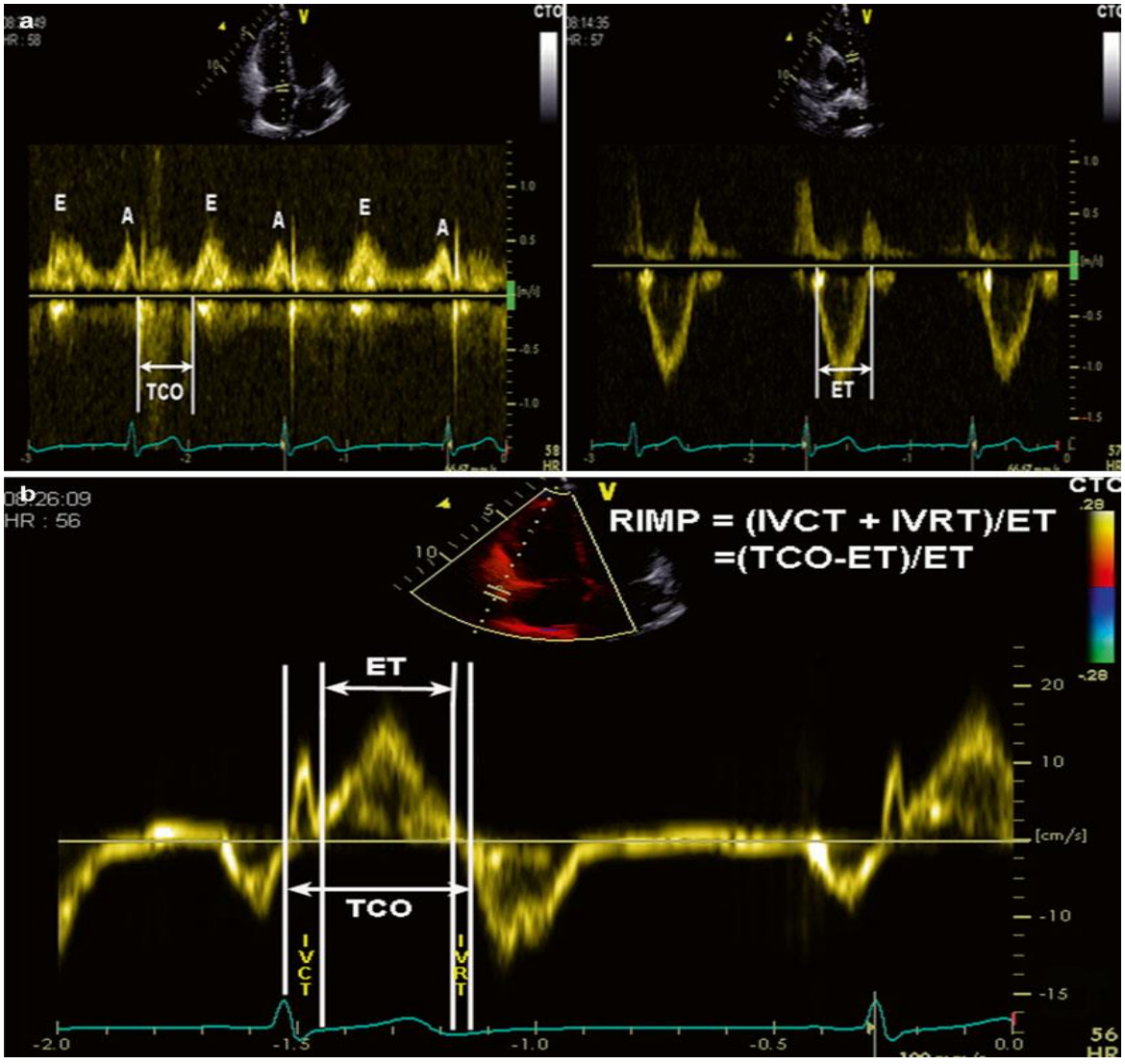

Figure 2 Measurement of RV myocardial performance index (MPI) or RIMP by pulsed Doppler (a) and pulsed tissue Doppler (b)

4. DISCUSSION

In this study, the early and mid-term effects of MVR on RV function was studied by the mean of two-dimensional and TDI echocardiography. Our hypothesisis that after successful MVR, pulmonary artery pressure could regress after mid to long term, the same point was studied by Hirata et al (Hirata et al., 1992), but on the effect of PMBV (ballon valvuloplasty) .

Trapezoidal RV anatomy renders the quantitative evaluation by echocardiograph highly difficult. Numerous novel methods are used nowadays for RV evaluation as MRI, radionuclide ventriculography and cardiac catheterization; however, none of them is reproducible (Helbing et al., 1995, Rumberger et al., 1997). In contrary to echocardiography which can be largely relied on, it is available, rapid, bed-side test and slightly affected by physiological changes in flow velocities (İnci et al., 2015).

In the present study, there were high statistically significant differences between the different periods as regarding LVDD, LVSD, Mean GR, LA area and LVEF%. Moreover, there were high statistically significant differences between preoperative with other periods as regard LVDD, LVSD, Mean GR, La and LVEF%, same results when compared with a study named "Changes in left ventricular morphology and function after Mitral Valve Surgery" concluded that a positive response toward normalization of LV morphology and function post mitral valve surgery was very high 1st year. Best response is obtained when surgery is performed pre left heart dilatation, LV hypertrophy, or LV dysfunctions develop (Shafii et al., 2012).

Regarding RV echocardiographic evaluation, our investigation showed are covering of the right ventriclar function ((decreasing in RV MPI, and pulmonary arterial pressure and an increase in TAPSE, systolic and diastolic wave velocities) immediately post MVR could be explained by the recovering of RV outflow tract systolic functions due to the acute decrease in RV after load, , In the form of high statistically significant difference between the different periods as regard PASP, RVFAC, TAPSE, TR jet area/RAA and RA maximum volume, and there was high statistically significant difference between preoperative with each other periods as regard PASP, RVFAC, TAPSE, TR jet area/RAA and RA maximum volume, statistically significant difference between preoperative with 3 months and 6 months after operation as regard TAPSE, statistically significant difference between preoperative with 6 months after operation as regard RA maximum volume. Comparable results were found in study made by Santosh et al., (2015) named "Immediate impact of successful percutaneous mitral valve commissurotomy on RVF".

Up to 61.54% of cases with normalized RV systolic function post PTMC succession that was supported our observation Hamdy (2011). While Mohan, et al., (1999) reported that, 65% of cases were improved (systolic function) throughout 1styear and RV systolic function returned to normality . Mohan et al., (1999) found in twenty five cases with isolated rheumatic mitral stenosis pre, immediately post (mean, 40±12 h) and at follow-up of 11.5 months and after PTMC succession, RV global function went to normalization in two-thirds cases.

On comparing the two groups it was notable that the immediate drop in pulmonary artery pressure occurred in acute period in group (I) was sustained during 6 months follow-up; however, group (II) showed signs of PASP re-elevation which was not completely understood but it might be due to irreversible changes in the pulmonary vascular bed in the group with high PASP presented with a pseudo-improvement for a given time due to the decreased post-MVR after load.

Present study illustrated that, the recovery of RV function in group (II) started to lose significance in the 6 months follow up (Increasing MPI, pulmonary arterial pressure and reducing TAPSE). Initial similar results were achieved in group (I), but unlike group (II) the improved RVF were maintained. Malhotra et al., (1987) found that intra myocardial branches of myocardial vessels were involved in active rheumatic vasculitis form or inactive lesions characterized by medial hypertrophy and replacing fibrosis for the affected rheumatic heart.

Obtained results agreed with Santosh et al., (2015) reported RVF shortening and improving in systolic functions, (Tei index), post mitral valve surgery succession. Regression of RV systolic pressure by demonstrating increases RVF without pulmonary HT and improves mid-term follow up function. As well as Mahfouz et al., (2013) noted that, decrement in pulmonary hypertension and increasing in TAPSE as RVF assessment after PTMC follow up.

Our obtained results were in consistent with İnci et al., (2015) reported in their study that the value of the mean gradient, pulmonary artery pressure (PAP) and RA maximal volume were decrease significantly after PMBV. PAP max and RA volumes start to increase again in 3thmonth and 1st year follow-up measure and significance lost at end 1styear. Wilkins score was decrease post PMBV success and follow-up time, TAPSE and RVFAC were increase after PMBV and reach to basal levels during follow-up measurements and loss at end in1st year. Deceleration time, pre-ejection period, peak, and myocardial performances index, ejection time and E peak were increase significantly after PMBV succession, lost of MPI significantly at end of 1st year.

5. CONCLUSION

Right ventricle functions were improved after MVR throughout the short term follow up; however, the observed recovery decreased in cases with high PASP (group II) through early and mid-term follow-ups. Which give us indication that intervention in MS cases is

very important prior to developing latent right ventricle myocardial dysfunction. However, more investigations with high patients' numbers are needed to evaluate if the findings have any prognostic implication.

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Conflict of interest
The author declares that there are no conflicts of interest.

Informed consent
Written & Oral informed consent was obtained from all individual participants included in the study.

Ethical approval
The ethical approval cleared by the ethical committee of Faculty of Medicine, Assiut University, Egypt (Ethical approval code: 17200200).

Data and materials availability
All data associated with this study are present in the paper.

Peer-review
External peer-review was done through double-blind method.

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