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RIGHT VENTRICULAR FUNCTIONAL ASSESSMENT BY ECHOCARDIOGRAPHY IN PRE AND POST BALLOON MITRAL VALVULOPLASTY IN PATIENTS WITH SEVERE RHEUMATIC MS

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ABSTRACT

Introduction: Rheumatic heart disease causes significant morbidity and mortality. Mitral stenosis (MS) is the commonest presentation in rheumatic heart disease. Rheumatic heart disease is an immunologic phenomenon that may affect any of the heart valves and the myocardium Rheumatic MS is a frequent cause of valve disease in developing countries.

Aims : To assess Right Ventricular function before BMV, 48 hours and 3 months after the BMV in cases of severe Mitral stenosis using Echocardiography, Mitral valve area changes with changes in Right ventricular function and correlate Pulmonary hypertension with Right ventricular function echocardiographically before and after BMV.

Materials and method: A cross-sectional, observational study was conducted in Department of Cardiology, NRS Hospital, Kolkata. This study of period was June, 2020 to December, 2021 (18 academic months). 100 patients were included in this study.

Result: We found that In One-Sample Statistics, the mean TAPSE Pre of patients was 13.85 ± 1.749, the mean TAPSE 24-48 Hrs of patients was 14.52 ± 1.624 and the mean TAPSE after 3 Months of patients was 16.79 ± 1.066. It was found that Mean difference of TAPSE was statistically significant. In One-Sample Statistics, the mean RIMP (DTI <0.53) Pre of patients was .5687 ± .03265, the mean RIMP (DTI <0.53) 24-48 Hrs of patients was .5522 ± .02013 and the mean RIMP (DTI <0.53) after 3 Months of patients was .5322 ± .01812.Mean difference of RIMP (DTI <0.53) was statistically significant. In One-Sample Statistics, the mean S' (>10) Pre of patients was 8.82± .796, the mean S' (>10) 24-48 Hrs of patients was 10.27± 1.441 and the mean S' (>10) after 3 Months of patients was 11.28± 1.026. It was found that in One-Sample Test, mean difference of S' (>10) Pre was 8.820 with 95% confidence interval [8.66–8.98, P < 0.0001]. Mean difference of S' (>10) 24-48 Hrs was 10.270 with 95% confidence interval [9.98–

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10.56, P < 0.0001]. Mean difference of S' (>10) after 3 Months was 11.280 with 95% confidence interval [11.08–11.48, P < 0.0001].

Conclusion: we conclude that, Right Ventricular function before BMV, 48 hours and 3 months after the BMV in cases of severe Mitral stenosis using Echocardiography, compared Mitral valve area changes and correlate Pulmonary hypertension with Right ventricular function echocardiographically before and after BMV.

Keywords: Acute Coronary Syndrome, clinical profile and various pattern.

INTRODUCTION

Rheumatic heart disease causes significant morbidity and mortality. Mitral stenosis (MS) is the commonest presentation in rheumatic heart disease. Rheumatic heart disease is an immunologic phenomenon that may affect any of the heart valves and the myocardium Rheumatic MS is a frequent cause of valve disease in developing countries. Since its introduction in 1984 by Inoue et al Percutaneous Transvenous Mitral Commissurotomy (PTMC)has become established as a safe and effective treatment for rheumatic MS and remains the treatment of choice in patients with a favorable anatomy.

The Right Ventricular (RV) function is an important determinant of clinical symptoms, exercise capacity, pre-operative survival and postoperative outcome in patients with MS. In patients with MS, the RV function may be altered due to an increase in the left atrial pressure and/or changes in the pulmonary arteriolar vasculature or may be affected by the rheumatic process directly [1].

RV dysfunction is usually over looked before the emergence of clinical signs of systemic venous congestion because of difficulties in the quantitative assessment of RV function. Now a days, a novel method, 2D strain, has been developed for the quantitative assessment of global and regional myocardial function.

Reduced exercise capacity and fatigue are common symptoms in patients with MS; increased pulmonary venous pressure and left atrium (LA) are not the solely responsible factors for these symptoms [2]. Right ventricular (RV) function plays an important role in the development of clinical symptoms, exercise capacity, prognosis, and survival in MS [10, 11].

AIMS AND OBJECTIVES

1. To assess Right Ventricular function before BMV, 48 hours and 3 months after the BMV in cases of severe Mitral stenosis using Echocardiography.
2. To compare Mitral valve area changes with changes in Right ventricular function
3. To correlate Pulmonary hypertension with Right ventricular function echocardiographically before and after BMV.

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MATERIALS AND METHODS

Study Population

Patients aged between 18years to 45 years with severe rheumatic mitral stenosis (MS) who had attend Cardiology OPD, NRS Hospital and eligible for PBMV were included in this study. Written informed consent was to be taken from patient or their relatives in their own language before enrollment in the study.

Study area

Department of Cardiology, NRS Hospital, Kolkata

Study Period

June, 2018 to December, 2019 (18 academic months)

Study Design

A cross-sectional, observational study involving 100 patients aged between 18 to 45 years who was fulfill inclusion criteria. Pre-PBMV Echocardiographic data was taken and recorded. After completion of successful PBMV as denoted by Mitral valve area>1.5 cm2 and reduction of pressure gradient across mitral valve >50% with no significant mitral regurgitation (MR). Follow up echocardiographic evaluation had done after 48 hours of procedure, and at 3 months.

Sample Size

Expected 100 patient likely to be enrolled for this study.

Parameters Studied

Inclusion criteria

1. All the patients were in New York Heart class >=II and<IV.
2. Moderate to severe MS (i.e., a mitral valve area <1 cm2/m2body surface area (BSA) or <1.5 cm2 in normal-sized adults.
3. Suitable valve morphology by echocardiographic criteria.
4. Absence of concomitant cardiovascular disease requiring surgical correction.

Exclusion criteria

1. Systemic hypertension.
2. Diabetes mellitus.
3. More than mild mitral or aortic regurgitation and/or aortic stenosis.
4. Lung diseases.
5. Pulmonary valve disease.
6. Previous aortic or mitral valve surgery.
7. Absence of concomitant cardiac disease requiring surgery.
8. Echocardiographic criteria for contraindications of balloon valvuloplasty e.g. mitral regurgitation grade III or IV, left atrial thrombus, heavily calcified mitral valve annulus, commissural calcification and heavy sub valvular affection.

RESULT AND DISCUSSION

A cross-sectional, observational study was conducted in Department of Cardiology, NRS Hospital, Kolkata. This study of period was June, 2018 to December, 2019 (18 academic months). 100 patients were included in this study.

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We found that in One-Sample Statistics, the mean LVEF Pre-Op of patients was 60.60 ± 4.195, the mean LV EF after 24-48 hrs of patients was 60.74 ± 3.969, the mean LV EF after 3 Months of patients was 59.92 ± 3.784. Mean difference of LVEF Pre-Op and after 24-48 hrs was statistically significant.

Our study showed that In One-Sample Statistics, the mean MVA Planimetry Pre-Op of patients was .782 ± .1290, mean MVA Planimetry after 24-48 hrs of patients was 1.631 ± .1666, the mean MVA Planimetry after 3 Months of patients was 1.8090 ± .09221. Difference of mean difference of MVA Planimetry was statistically significant. We found that In One-Sample Statistics, the mean MVA PHT Pre-Op of patients was 268.28 ± 26.755, the mean MVA PHT after 24-48 hrs of patients was 197.64 ± 7.864, mean MVA PHT after 3 Months of patients was 171.13 ± 10.493. Difference of mean MVA PHT was statistically significant. It was found that In One-Sample Statistics, the mean Peak Pressure Gradient Pre-Op of patients was 25.07 ± 3.652, the mean Peak Pressure Gradient after 24-48 hrs of patients was 14.13 ± 2.549, the mean Peak Pressure Gradient after 3 Months of patients was 9.98 ± 1.786. Difference of mean difference of Peak Pressure Gradient was statistically significant. We found that In One-Sample Statistics, the mean of Mean Pressure Gradient Pre-Op of patients was 14.17 ± 2.161, the mean of Mean Pressure Gradient (24-48 hrs) of patients was 7.43 ± 1.217 and the mean of Mean Pressure Gradient after 3 Months of patients was 6.53 ± 1.150. Difference of mean Pressure Gradient was statistically significant.

Kumar V et al [5] (2014) found that right ventricular (RV) dysfunction in isolated severe mitral stenosis (MS) patients have prognostic significance. Study aim was to assess RV function in these subjects by strain and strain rate analysis, pre and post-balloon mitral valvuloplasty (BMV). In addition, they had higher estimated pulmonary artery systolic pressure and RV myocardial performance index; lower tricuspid annular plane systolic excursion (TAPSE), peak systolic velocity at lateral tricuspid annulus, isovolumic acceleration and fractional area change (FAC).

Our study showed that In One-Sample Statistics, the mean RV Basal Diameter (25-41) Pre of patients was 43.88 ± 2.599, the mean RV Basal Diameter (25-41) 24-48 Hrs of patients was 43.37 ± 2.102 and the mean RV Basal Diameter (25-41) after 3 Months of patients was 41.54 ± 1.234. Difference of mean RV Basal Diameter was statistically significant.

In One-Sample Statistics, the mean Mid RV (19-35) Pre of patients was 37.35 ± 1.500, the mean Mid RV (19-35) 24-48 Hrs of patients was 37.38 ± 1.427 and the mean Mid RV (19-35) after 3 Months of patients was 33.42 ± 1.838. Difference of mean RV Basal Diameter was statistically significant. We found that In One-Sample Statistics, the mean Distal RV OT(<28) Pre of patients was 29.83 ± 2.383, the mean Distal RVOT (<28) 24-48 Hrs of patients was 28.42 ± 2.358 and the mean Distal RV OT after 3 Months of patients was 25.53 ± 1.243.

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It was found that In One-Sample Statistics, the mean RV wall Thickness (1 to 5) Pre of patients was 4.30 ± .628, the mean RV wall Thickness (1 to 5) 24-48 Hrs of patients was 4.44 ± .795 and the mean RV WALL Thickness after 3 Months of patients was 4.18 ± .626.It was found that in One-Sample Test, mean difference of RV wall Thickness (1 to 5) Pre was 4.300 with 95% confidence interval [4.18–4.42, P < 0.0001]. Mean difference of RV wall Thickness (1 to 5) 24-48 Hrs was 4.440 with 95% confidence interval [4.28–4.60, P < 0.0001]. Mean difference of RV WALL Thickness after 3 Months was 4.180 with 95% confidence interval [4.06–4.30, P < 0.0001].

İnciS et al [6](2015) found that Right ventricular functions were measured before, immediately after, and at 3 months and 1 year after PMBV by conventional and tissue Doppler echocardiography imaging methods. Additionally, the patients were evaluated in two groups (PAP≥40 mm Hg, n: 46; PAP<40 mm Hg, n: 15) according to the systolic pulmonary artery that was measured by echocardiography prior to PMBV. Post-PMBV TAPSE, systolic velocity, early diastolic velocity, IVV, and IVA increased significantly, and this increase was maintained up to 1 year in the group without pulmonary hypertension. MPI and late diastolic velocity maintained their significantly decreased values up to 1 year..

We found that In One-Sample Statistics, the mean TAPSE Pre of patients was 13.85 ± 1.749, the mean TAPSE 24-48 Hrs of patients was 14.52 ± 1.624 and the mean TAPSE after 3 Months of patients was 16.79 ± 1.066. It was found that Mean difference of TAPSE was statistically significant.

In One-Sample Statistics, the mean RIMP (DTI <0.53) Pre of patients was .5687 ± .03265, the mean RIMP (DTI <0.53) 24-48 Hrs of patients was .5522 ± .02013 and the mean RIMP (DTI <0.53) after 3 Months of patients was .5322 ± .01812.Mean difference of RIMP (DTI <0.53) was statistically significant.

Our study showed that In One-Sample Statistics, the mean FAC (>35%) Pre of patients was 31.76± 2.075, the mean FAC (>35%) 24-48 Hrs of patients was 34.56± 1.976 and the mean FAC (>35%) after 3 Months of patients was 37.09± 1.198.It was found that in One-Sample Test, mean difference of FAC (>35%) Pre was 31.760 with 95% confidence interval [31.35–32.17, P < 0.0001]. Mean difference of FAC (>35%) 24-48 Hrs was 34.560 with 95% confidence interval [34.17–34.95, P < 0.0001]. Mean difference of FAC (>35%) after 3 Months was 37.090 with 95% confidence interval [36.85–37.33, P < 0.0001].

Ahmed MK et al [7] (2015) found that the RV function was evaluated by both conventional echo and Doppler tissue imaging. Conventional echo could not detect significant changes between the two groups, while using DTI the symptomatic group was found to show a significantly lower E′ wave peak velocity (P = 0.005), E′/A′ ratio (P = 0.009), S wave peak velocity (P = 0.033), IVC

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max (P = 0.02) and IVA (P = 0.001). Patient with impaired RV function as detected by DTI are more symptomatic than other with better RV function and of similar MVA.
In One-Sample Statistics, the mean S' (>10) Pre of patients was 8.82± .796, the mean S' (>10) 24-48 Hrs of patients was 10.27± 1.441 and the mean S' (>10) after 3 Months of patients was 11.28± 1.026.It was found that in One-Sample Test, mean difference of S' (>10) Pre was 8.820 with 95% confidence interval [8.66–8.98, P < 0.0001]. Mean difference of S' (>10) 24-48 Hrs was 10.270 with 95% confidence interval [9.98–10.56, P < 0.0001]. Mean difference of S' (>10) after 3 Months was 11.280 with 95% confidence interval [11.08–11.48, P < 0.0001].

We found that In One-Sample Statistics, the mean E/A Pre(1.5) of patients was 1.475± .4598, the mean E/A 24-48 Hrs of patients was 1.471± .4416 and the mean E/A after 3 Months of patients was 1.523± .1620.Mean difference of E/A was statistically significant. In One-Sample Statistics, the mean E/E' Ratio Pre(<15) of patients was 17.28± 1.272, the mean E/E' Ratio 24-48 Hrs (<15) of patients was 16.89± 1.180 and the meanE/E' Ratio after 3 Months of patients was 15.02± 1.247.Mean difference of E/E' Ratio was statistically significant.

We found that In One-Sample Statistics, the mean RVDT Pre of patients was 140.77± 6.515, the mean RVDT 24-48 Hrs of patients was 137.10± 6.167 and the mean RVDT after 3 Months of patients was 128.05± 7.933. It was found that in One-Sample Test, mean difference of RVDT Pre was 140.770 with 95% confidence interval [139.48–142.06, P < 0.0001]. Mean difference of RVDT 24-48 Hrs was 137.100 with 95% confidence interval [135.88–138.32, P < 0.0001]. Mean difference of RVDT after 3 Months was 128.050 with 95% confidence interval [126.48–129.62, P < 0.0001].

It was found that in One-Sample Test, mean difference of PASP Pre was 48.610 with 95% confidence interval [46.94–50.28, P < 0.0001]. Mean difference of PASP24-48hrs was 40.170 with 95% confidence interval [38.46–41.88, P < 0.0001]. Mean difference of PASP after 3Months was 33.420 with 95% confidence interval [32.11–34.73, P < 0.0001].
In One-Sample Statistics, the mean RV GLS PRE -19%to -28% of patients was -17.74± 1.397, the mean RV GLS 24-48hrs of patients was -18.843± 1.3966 and the mean RV GLS after 3Months of patients was -21.418± 1.7179.We found that In One-Sample Statistics, the mean RAP Pre of patients was 6.92± 1.762, the mean RAP 24-48hrs of patients was 6.56± 1.493andthe mean RAP after 3 months of patients was 4.68± 1.150.
Vijay SK et al [8] (2019) found that LV and RV rotational parameters were also reduced. BMV significantly improved in left ventricular GL strain from baseline (-13.10 ± 3.67) to post 24-48 hrs (-14.77 ± 3.98) and post one month (-17.20 ± 3.44) and GC strain from baseline (-19.18 ± 7.58, p=<0.05). RV global longitudinal strain also changed significantly (p < 0.01) from baseline (-9.43 ± 5.75) to post 24-48 hrs (-13.87 ± 8.93) and post one month (-17.37 ± 5.72).
It was showed that In One-Sample Statistics, the mean MR Pre-Op of patients was .43± .498and the mean MR after 24-48 hours of patients was .92± .677.It was found that in One-Sample Test,

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mean difference of MR Pre-Op was .430 with 95% confidence interval [.33–.53, P < 0.0001]. Mean difference of MR after 24-48 hours was .920 with 95% confidence interval [.79–1.05, P < 0.0001]. We found that In One-Sample Statistics, the mean LAD pre bmv of patients was 60.17± 50.089, the mean LAD 24-48 hours of patients was 54.75± 6.442 and the mean LAD after 3 months of patients was 46.66± 5.064.It was found that in One-Sample Test, mean difference of LAD pre bmv was 60.170 with 95% confidence interval [50.23–70.11, P < 0.0001]. Mean difference of LAD 24-48 hours was 54.750with 95% confidence interval [53.47–56.03, P < 0.0001]. Mean difference of LAD after 3 months was 46.660with 95% confidence interval [45.66–47.66, P < 0.0001].

Sowdagar MA et al [9] (2018) found that Increment in MVA positively correlated with Tricuspid annular plane systolic excursion (TAPSE) and tricuspid annular Sm and isovolumic contraction velocity (IVCV) and inversely with left atrium (LA) size and Pulmonary arterial systolic pressure (PASP) ($p = 0.01$ for LA size; $p<0.001$ for others) while no such correlation was found with mitral annulus isovolumic acceleration (IVA) ($r = 0.078$; $p = 0.679$).

Roushdy AM et al [10](2015) found that there was significant positive correlation between both LV and RV GLS at baseline and mitral valve mean pressure gradient and RV systolic pressure and significant inverse correlation between LV GLS and MVA. MS patients have subclinical LV and RV systolic dysfunction by GLS despite normal ejection fraction and fractional area change. A mixed aetiology theory involving a myocardial as well as a haemodynamic factor is believed to be the cause for this subclinical biventricular dysfunction and its improvement at short-term follow-up post-BMV.

Our study showed that the negative correlation was found in TAPSE Pre vs MVA Planimetry Pre-Op and this correlation was not statistically significant. The negative correlation was found in RIMP (DTI <0.53) Pre vs MVA Planimetry Pre-Op and this correlation was not statistically significant. The positive correlation was found in FAC (>35%) Pre vs MVA Planimetry Pre-Op and this correlation was statistically significant. The negative correlation was found in S' (>10) Pre vs MVA Planimetry Pre-Op and this correlation was not statistically significant. The negative correlation was found in E/A Pre (1.5) vs MVA Planimetry Pre-Op and this correlation was statistically significant. The positive correlation was found in E/E' Ratio Pre (<15) vs MVA Planimetry Pre-Op and this correlation was not statistically significant. The positive correlation was found in RVDT Pre vs MVA Planimetry Pre-Op and this correlation was not statistically significant. The negative correlation was found in RV GLS PRE -19% to -28% vs MVA Planimetry Pre-Op and this correlation was not statistically significant. The positive correlation was found in RAP Pre vs MVA Planimetry Pre-Op and this correlation was statistically significant. The positive correlation was found in PASP Pre vs MVA Planimetry Pre-Op and this correlation was not statistically significant. The negative correlation was found in RV Basal Diameter (25-41) Pre vs MVA Planimetry Pre-Op and this correlation was statistically significant.

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We got the positive correlation was found in TAPSE 24-48 Hrs. vs MVA Planimetry after 24-48 hrs. and this correlation was not statistically significant. The negative correlation was found in RIMP (DTI <0.53) 24-48 Hrs. vs MVA Planimetry after 24-48 hrs. and this correlation was not statistically significant. The negative correlation was found in FAC (>35%) 24-48 Hrs. vs MVA Planimetry after 24-48 hrs. and this correlation was not statistically significant. The positive correlation was found in S' (>10) 24-48Hrs. vs MVA Planimetry after 24-48 hrs. and this correlation statistically significant. The positive correlation was found in E/A 24-48 Hrs. vs MVA Planimetry after 24-48 hrs. and this correlation was not statistically significant. The negative correlation was found in E/E' Ratio 24-48 Hrs. (<15) vs MVA Planimetry after 24-48 hrs. and this correlation was not statistically significant. The positive correlation was found in RVDT 24-48 Hrs. vs MVA Planimetry after 24-48 hrs. and this correlation was statistically significant. The positive correlation was found in RV GLS 24-48hrs. vs MVA Planimetry after 24-48 hrs. and this correlation was statistically significant. The negative correlation was found in RAP 24-48hrs. vs MVA Planimetry after 24-48 hrs. and this correlation was not statistically significant. The positive correlation was found in PASP 24-48hrs vs MVA Planimetry after 24-48 hrs. and this correlation was statistically significant. The negative correlation was found in RV Basal Diameter (25-41) 24-48 Hrs. vs MVA Planimetry after 24-48 hrs. and this correlation was not statistically significant.

We found The negative correlation was found in TAPSE 3 Months vs MVA Planimetry after 3Months and this correlation was statistically significant. The negative correlation was found in RIMP (DTI <0.53) 3 Months vs MVA Planimetry after 3Months and this correlation was not statistically significant. The positive correlation was found in FAC (>35%) 3 Months vs MVA Planimetry after 3Months and this correlation was not statistically significant. The positive correlation was found in S' (>10) 3 Months vs MVA Planimetry after 3Months and this correlation was statistically significant. The negative correlation was found in E/A 3 Months vs MVA Planimetry after 3Months and this correlation was statistically significant. The negative correlation was found in E/E' Ratio 3 Months vs MVA Planimetry after 3Months and this correlation was not statistically significant. The positive correlation was found in RVDT 3 Months vs MVA Planimetry after 3Months and this correlation was not statistically significant. The negative correlation was found in RV GLS 3Months vs MVA Planimetry after 3Months and this correlation was not statistically significant. The positive correlation was found in RAP 3 Months vs MVA Planimetry after 3Months and this correlation was not statistically significant. The negative correlation was found in PASP 3 Months vs MVA Planimetry after 3Months and this correlation was statistically significant. The negative correlation was found in RV Basal Diameter (25-41) 3 Months vs MVA Planimetry after 3 Months and this correlation was statistically significant.

CONCLUSION

We found that Change of LVEF, MVA Planimetry, MVA PHT, Peak Pressure Gradient and Mean Pressure Gradient were statistically significant.

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It was also found that Change of RV Basal Diameter, Mid RV, Distal RV OT, RV wall Thickness, TAPSE and RIMP (DTI <0.53) were statistically significant.

Our study showed that Change of FAC, S', E/A, E/E', RVDT and PASP were statistically significant.

It was also found that Change of RV GLS, RAP, MR, LAD were statistically significant.

The positive correlation was found in MVA Planimetry Pre-Op with FAC pre and RAP Pre and the negative correlation was found in MVA Planimetry Pre-Op with E/A Pre and RV Basal Diameter Pre which were statistically significant.

The positive correlation was found in MVA Planimetry after 24-48 hrs with S' (>10) 24-48 Hrs, RVDT 24-48 Hrsand RV GLS 24-48hrsand the negative correlation was found in MVA Planimetry after 24-48 hrs with RV Basal Diameter Pre which were statistically significant.

The positive correlation was found in MVA Planimetry at 3 month with S' (>10) 3 Months and the negative correlation was found in MVA Planimetry Pre-Op with TAPSE 3 Months, E/A 3 Months, PASP 3Monthsand RV Basal Diameter Pre which were statistically significant.

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Table: Distribution of mean MVA Planimetry Pre-Op, MVA Planimetry after 24-48 hrs and MVA Planimetry after 3 Months

One-Sample Statistics				
	N	Mean	Std. Deviation	Std. Error Mean
MVA Planimetry Pre-Op	100	.782	.1290	.0129
MVA Planimetry after 24-48 hrs	100	1.631	.1666	.0167
MVA Planimetry after 3 Months	100	1.8090	.09221	.00922

Table: Difference of mean MVA Planimetry Pre-Op, MVA Planimetry after 24-48 hrs and MVA Planimetry after 3 Months

One-Sample Test						
	Test Value = 0					
	t	df	P-value	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
MVA Planimetry Pre-Op	60.618	99	<0.0001	.7820	.756	.808
MVA Planimetry after 24-48 hrs	97.862	99	<0.0001	1.6306	1.598	1.664
MVA Planimetry after 3 Months	196.190	99	<0.0001	1.80900	1.7907	1.8273

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Table: Correlation of MVA Planimetry Pre-Op with TAPSE, RIMP (DTI <0.53), FAC (>35%), S' (>10), E/A, E/E' Ratio, RVDT, RV GLS, RAP, PASP and RV Basal Diameter in pre-op.

		MVA Planimetry Pre-Op	Remarks
TAPSE Pre	Pearson Correlation Coefficient (r)	-.017	Negative correlation
	p-value	.870	Not statistically significant
	Number	100	
RIMP (DTI <0.53)Pre	Pearson Correlation Coefficient (r)	-.116	Negative correlation
	p-value	.251	Not statistically significant
	Number	100	
FAC (>35%)Pre	Pearson Correlation Coefficient (r)	.327**	Positive correlation
	p-value	.001	Statistically significant
	Number	100	
S' (>10) Pre	Pearson Correlation Coefficient (r)	-.012	Negative correlation
	p-value	.904	Not statistically significant
	Number	100	
E/A Pre(1.5)	Pearson Correlation Coefficient (r)	-.226*	Negative correlation
	p-value	.024	Statistically significant
	Number	100	
E/E' Ratio Pre(<15)	Pearson Correlation Coefficient (r)	.074	Positive correlation
	p-value	.464	Not statistically significant
	Number	100	
RVDT Pre	Pearson Correlation Coefficient (r)	.186	Positive correlation
	p-value	.064	Not statistically significant
	Number	100	
RV GLS PRE -19%to -28%	Pearson Correlation Coefficient (r)	-.186	Negative correlation
	p-value	.063	Not statistically significant
	Number	100	
RAP Pre	Pearson Correlation Coefficient (r)	.216*	Positive correlation
	p-value	.031	Statistically significant
	Number	100	
PASP Pre	Pearson Correlation Coefficient (r)	.128	Positive correlation
	p-value	.204	Not statistically significant
	Number	100	
RV Basal Diameter (25-41) Pre	Pearson Correlation Coefficient (r)	-.232*	Negative correlation
	p-value	.020	Statistically significant
	Number	100	