Blood Pressure Monitoring: A noble method for stepwise decision making in percutaneous mitral valvuloplasty

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Citation

S Mahmoud, J Farahzad, D mahmoud, A Leila, F Mahla, M Hossein. *Blood Pressure Monitoring: A noble method for stepwise decision making in percutaneous mitral valvuloplasty*. The Internet Journal of Cardiology. 2009 Volume 8 Number 2.

Abstract

Background
: To find out if systolic blood pressure changes during percutaneous Mitral comissurotomy (PMC) could be a reliable guide to staged decision making and evaluate stop point.
Method:
102 patients with moderate to severe mitral stenosis were chosen for PMC with Inue technique. Echocardiographic and homodynamic criteria were used as references for decision making during procedure .Systolic blood pressure changes were also evaluated by a fluid filled system at the end of each balloon inflation and deflation. To reach optimal results balloon inflation was done only once in one case (0.98%),twice in16.66% and three times in 82.35% of cases .in every stage of balloon inflation, trans-mitral gradient was compared with changes in systolic blood pressure.
Results:
correlation between systolic blood pressure drop and trans-mitral gradient changes were analyzed with Pearson method and via regression formula. Relation between final mitral orifice area and systolic blood pressure was also analyzed with T test. Significant relation was found in every stage:R;0.63 in stage 1,R:0.823 in stage 2, R:673in stage 3 in regression formula.
Discussion:
In order to find an easy and reliable method to assess results of PMC ,we chose systolic blood pressure changes ,because it could be reached via Gorlin formula and theoretically is related to mitral orifice area, practically it is easy to obtain in cath- lab, significant statistical relation was obtained with Pearson correlation and T test.

Conclusion:
Quick assessment of success during PMC is possible with monitoring of systolic blood pressure changes, an easy and practical way we could rely on.

INTRODUCTION

Until the first publication by Inoue and coworkers on percutaneus mitral commissurotomy (PMC) in 1984, surgery was the only treatment for patients with mitral stenosis. Most reports concerning PMC have been published since 1986. Since then a considerable evolution in this technique has occurred. A large number of patients have now been treated, enabling efficacy and risk to be assessed, and midterm results are available, so we are better able to select the most appropriate candidates for treatment by this method [(1)]

Serial homodynamic measurement alone or in combination with echocardiography, may be used to evaluate the result achieved with PMC. [1]

An immediate improvement in left atrial mean pressure (and reduction of the transmitral gradient) should be seen, with a gradual decrease in pulmonary artery pressure and an increase in cardiac output. Criteria for termination of procedure include: 1) a mitral valve area larger than 1 cm^2 per square meter of body surface area. 2) Complete opening of at least one commissure or 3) appearance of an increase in mitral regurgitation. [1,2]

In our cath lab, stepwise decision making and confirm of the stop point is based on hemodynamic measurements. By pooling back the catheter from left atrium to left ventricle after each inflation, the residual gradient and mitral regurgitataion are evaluated. But this technique lacks practibility and may be subjected to error. So we are presenting a novel method for stepwise decision making and for determing acute results after each stage of balloon inflation.

MATERIAL AND METHODS

Our study was performed between years 2002-2004 in catheterization department of Imam Reza hospital in Mashhad-Iran.

We had 102 patients with moderate to severe MS whom were referred to our center for PMC (percutaneus mitral commissurotomy).

Ttrans-thorasic echocardiography was performed in all cases pre-procedure. Patients with Wilkin's score more than 12 were excluded from our study. We also excluded cases with more than two plus mitral regurgitation, and cases with other valvular involvement and inter-atrial septal defect. Demographic and hemodynamic data are shown in Table-1.

Figure 4

		Gradient Before	Blood Pressure Before	M.V.A. before	Gradient After1	Gradient After2	Gradient After3
N	Valid	102	102	102	102	101	84
	Missing	0	0	0	0	1	18
Mean		17.39	98.65	.9618	12.85	7.56	3.71
Median		18.00	100.00	1.0000	12.00	8.00	2.00
Mode		15[a]	100	1.00	12	8	2
Std. Deviation		4.70	12.92	.1280	4.91	5.15	4.74
Minimum		8	10	.60	2	0	0
Maximum		30	121	1.20	25	22	22

		Blood Pressure After1	Blood Pressure After2	Blood Pressure After3	M.V.A after	VBP1	VBP2
N	Valid	102	101	86	102	102	101
	Missing	0	1	16	0	0	1
Mean		104.44	111.68	111.76	1.8681	5.79	12.97
Median		105.00	112.00	115.00	1.9000	5.00	13.00
Mode		105	115	120	2.00	5	13
Std. Deviation		9.94	10.01	19.67	.2718	8.96	10.39
Minimum		85	85	2	.80	0	-7
Maximum		130	135	140	2.20	88	98

		VBP3	VGR1	VGR2	VGR3	TMV
N	Valid	86	102	101	84	102
	Missing	16	0	1	18	0
Mean		13.73	-4.54	-9.88	-14.67	.9064
Median		17.00	-4.00	-10.00	-15.00	.9750
Mode		15[a]	-3	-11	-17[a]	1.00
Std. Deviation		20.32	2.84	4.05	5.17	.2419
Minimum		-99	-13	-18	-25	.00
Maximum		98	0	0	0	1.30

a. Multiple modes exist. The smallest value is shown

VBP 1 ,2,3 means: Variations in systolic blood pressure in stage 1, 2 and 3.

VGR 1, 2, 3 means: Variation in transmitral gradiant in stage 1, 2 and 3.

MVA: mitral valve area

TMV: mitral valve

Procedures were performed by Inoue method under local anesthesia. Pigtail catheter was placed in aortic root in order to measure systolic blood pressure. Balloon inflation was done in one, two, or three stages depending on homodynamic measurement of LA to LV gradient (residual gradient less than 6 mm hg was our gradient criteria for termination of procedure), also occurrence of new or accelerated mitral regurgitation and reach to termination criteria's mentioned before. Systolic blood pressure was assessed after each stage to be compared with other hemodynamic data. After terminating the procedure, transthorasic echocardiography was performed to confirm the hemodynamic findings and to be sure about the success or degree of mitral regurgitation.

In most cases we used transthorasic pressure half-time method by Doppler echocardiography. Planimetry of mitral valve area was also performed in some cases. Our criteria for stopping the procedure pulse to final echocardiographic assessment was hemodynamic data: 1) drop of transmitral gradient to less than 6 mmHg. 2) Developing or accelerating MR shown by changing morphology of V wave in LA

pressure curves. The endpoint could be reached after first, second and third stage of inflation. After each stage of balloon inflation, systolic blood pressure was measured via pig -tail catheter in aortic root. Findings are shown in Table-2. We analyzed data to evaluate if there is statistically significant relationship between immediate systolic blood pressure changes and degree of diastolic gradient drop between LA and LV, after each stage of balloon deflation. We also compared results of final mitral valve area at the end of procedure with final increase of blood pressure to determine if blood pressure changes have an acceptable relation with final standard results, interpreted by Doppler echocardiography.

Figure 2

Table 2: Results of T – test evaluating correlation of blood pressure changes with transmitral gradient and mitral valve area.

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	VBP1 & VGR1	102	-.378	.000
Pair 2	VBP2 & VGR2	101	-.432	.000
Pair 3	VBP3 & VGR3	84	-.140	.205
Pair 4	VBP1 & TMV	102	.086	.387
Pair 5	VBP2 & TMV	101	.278	.005
Pair 6	VBP3 & TMV	86	.109	.319

Paired Samples Test

		Paired Differences					t
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper	
Pair 1	VBP1 - VGR1	10.33	10.37	1.03	8.30	12.37	10.061
Pair 2	VBP2 - VGR2	22.85	12.68	1.26	20.35	25.35	18.111
Pair 3	VBP3 - VGR3	29.63	17.83	1.95	25.76	33.50	15.234
Pair 4	VBP1 - TMV	4.8877	8.9436	.8855	3.1311	6.6444	5.519
Pair 5	VBP2 - TMV	12.0649	10.3269	1.0276	10.0262	14.1035	11.741
Pair 6	VBP3 - TMV	12.8401	20.2932	2.1883	8.4892	17.1910	5.868

Paired Samples Test

		df	Sig. (2-tailed)
Pair 1	VBP1 - VGR1	101	.000
Pair 2	VBP2 - VGR2	100	.000
Pair 3	VBP3 - VGR3	83	.000
Pair 4	VBP1 - TMV	101	.000
Pair 5	VBP2 - TMV	100	.000
Pair 6	VBP3 - TMV	85	.000

RESULTS

Reaching termination criteria, balloon inflation was done only once in one case (0.98%), twice in 17 patients (16.66%) and three times in 84 cases (82.35%). So we had 287 cases of balloon inflation. Our failure was 4.9% which means in five cases we were not able to reduce the gradient or increase mitral valve area without developing mitral regurgitation. Three cases of severe MR developed at stage III of inflation. Final success rate was 95.1%.

Average of mitral valve area before the procedure was 0.96 cm2 which rised to 1.87 cm2 after the procedure .Homodynamic data are shown in table one.

In every single stage of balloon inflation (287 times) systolic blood pressure immediately (in first 30 seconds) after deflation of balloon was recorded and compared with transmitral gradient at the same time. Result were analyzed with Pearson correlation which showed there is a strong positive correlation between systolic blood pressure rise and decrease in transmitral gradient.P:0.475 in stage one ,P:534 in stage two and0.246 in stage three. Three cases with severe iatrogenic mitral regurgitation were excluded from this analyze. Final rise in systolic blood pressure was compared with final mitral valve area obtained by transthorasic echocardiography. These results were also analyzed by T test .Results of this test is shown in table two. Linear regression analyze was done in every single stage separately, results are shown in figure one, two and three.

Figure 3

Figure 1: Linear regression analyze in stage one of the procedure

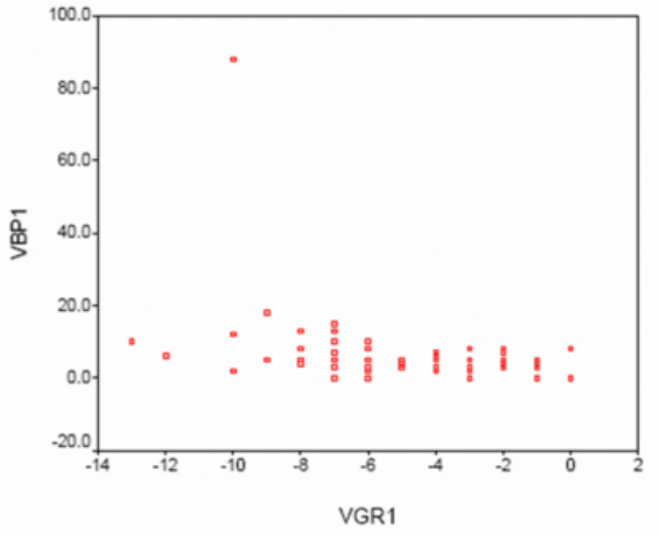
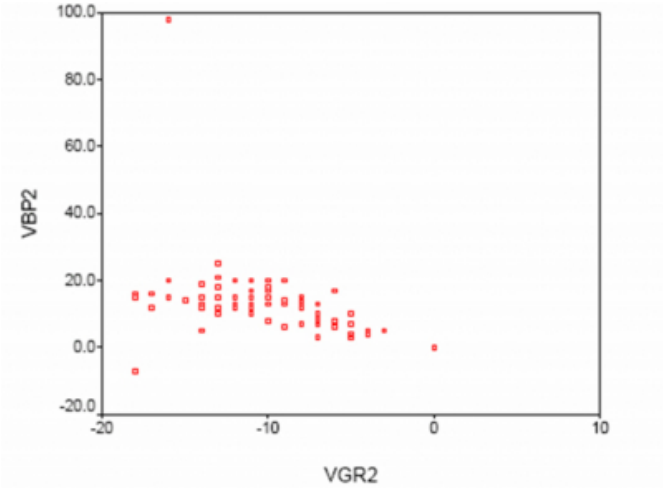


Figure 5

Figure 2: Linear regression analyze in stage 2 of the procedure

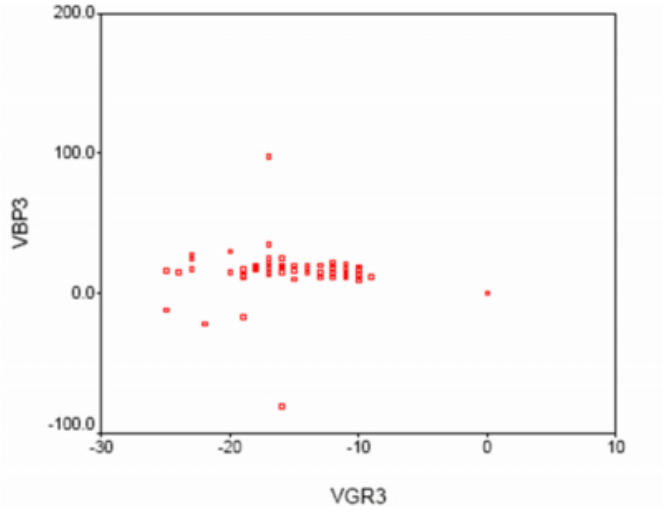


VBP1: Variation in blood pressure in stage 1

VGR1: Variation in transmitral gradient in stage 1

Figure 6

Figure 3 :Linear regression analyze in stage 3



VBP2: Variation in blood pressure in stage 2

VGR2: Variation in transmitral gradient in stage 2

{image:6}

VBP3: Variation in blood pressure in stage 3

VGR3: Variation in transmitral gradient in stage 3

DISCUSSION

Immediate effects of balloon mitral valvuloplasty (BMV) on systemic homodynamic and LV function in patients with mitral stenosis are still controversial, a general decrease in all intracardiac pressures related to medications and contrast agents may decrease the apparent transmitral gradient and make accurate measurement more difficult.(2) Tomai et al from Tor vergata university in Rome showed after successful BMV a transient lack of LV adaptation to the increased LV preload resulting in a persistently elevated LA pressure is predicted by higher baseline LV diastolic filling pressures and higher Wilkin's scores. It is promptly and steadily reversed by nitroglycerin administration through a transient LV unloading thus allowing a correct homodynamic evaluation of the immediate results of the procedure [(3)]. Rochan P et al in their research found cardiac index unchanged after BMV [(4).] Krishnamoorthy KM found a good correlation of pulmonary artery wedge pressure with LA pressure even in the presence of pulmonary arterial or venous hypertension. They concluded that PAW pressure can replace LA pressure monitoring in any clinical setting [(5).]

Harcombe AA et al compared echo-doppler gorline equation and homodynamic methods for measuring mitral valve stenosis during right ventricular pacing-induced tachycardia before and after Inoue mitral valvuloplasty to determine and they found that Gorline mitral valve area is the most heart rate independent indicator of success following valvuloplasty [(6).] In this study also, we are used gorline formula for evaluating mitral valve area after BMV. We chose systolic blood pressure for quick assessment because it could be reached via gorline formula and it is easy to measure in cath lab without interrupting the procedure or changing location of the catheters. It is obvious that a strong positive correlation could exist between systolic blood pressure rise immediately after balloon deflation and transmitral gradient and also with mitral valve area. This fact could be discussed by gorline formula.

The mechanism of this phenomenon resembles Valsalva maneuver. In early phases of this maneuver venous return has pooled in venous system, with release of pressure, pooled blood will return to the heart and increases preload and by the frank-starling mechanism stroke volume will increase and as a result blood pressure increases. However in mitral valve stenosis this response has blunted due to relatively fixed blood flow through the mitral valve because of restricted valve orifice. In PMC, at the time of balloon inflation, blood has pooled in left atrium, resembling early phases of Valsalva maneuver; with deflation of balloon, blood will run off from left atrium to left ventricle, and

blood pressure will increase as consequence of increased preload and augmentation of stroke volume.

As we know blood pressure is multiply of systemic vascular resistance and CO

So if we could prove that other parameters in gorline formula dose not change significantly in one person during the procedure, we could rely on the direct relationship between BP and MVA changes. We considered HR changes negligible in our cases during the procedure. with exception of three complicated cases with MR, we had no significant heart rate changes. Because these three cases were omitted, we consider HR changes non-significant. But changes in vascular resistance remain a point to decrease accuracy of the relation, however there is still significant positive co-relation between transmitral gradient after each deflation and rise in systolic blood pressure. A positive correlation also exist between final mitral valve area and final rise in systolic blood pressure in the first beats after deflation.

CONCLUSION

According to the strong positive correlation between drop in trans-mitral diastolic gradient and systolic blood pressure changes after balloon deflation, we suggest using blood pressure monitoring as an easy and reliable method of quick assessment in every stage of balloon inflation. Strong correlation between blood pressure changes also exist with mitral valve area calculated with Doppler echocardiography.

More detailed studies are required to make distinct criteria of systolic blood pressure changes. When exact criteria is fully organized, stepwise decision making could be done without need to echocardiography or pulling back the catheter from left ventricle to left atrium. It would make the mitral valvuloplasty easier and possible to be done in a shorter period.

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