Echo Scoring Involving the Individual Parameter without Total Echo Scoring may be the Determining Factor for the Immediate Outcome of the Results of Percutaneous Transluminal Mitral Commissurotomy

*Kabir MS,[1] Majumder AS,[2] Bari MS,[3] Chowdhury AW,[4] Islam AM,[5] Haque SS,[6] Sarma PK[7]

Percutaneous transluminal mitral commissurotomy (PTMC) is a popular procedure for treatment of a selctive group of patients of mitral stenosis. Though echo-scoring by echocardiography is a popular method of patient selection it does not always correlate well with a good post-procedural outcome. To evaluate the echo parameters that favorably affect the outcome of PTMC a prospective observational study was carried out in NICVD, Dhaka, Bangladesh, over the period of 2000-2004, on 300 patients of mitral stenosis who underwent PTMC and post-procedural outcome was recorded. Successful procedures were defined as increase in mitral valve area (MVA) > 1.5 cm^2 or > 50% increase in pre-procedural MVA or ≥ 50% reduction in trans-mitral pressure gradient. Complications like cardiac tamponade, mitral regurgitation, and acute pulmonary edema were recorded. So far the echocardiographic variables are concerned, present study showed subvalvular changes and valvular calcifications are the most important factors to be evaluated appropriately for the best outcome of the procedure.

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Key words: *Echo scoring, percutaneous transluminal mitral commissurotomy.*

Introduction

In Bangladesh rheumatic mitral stenosis is a burden on the healthcare system though the prevalence of rheumatic fever is declining. Percutaneous transluminal mitral commissurotomy (PTMC) has become a popular procedure for these patients. Though echo scoring has been accepted to evaluate the patients for proper outcome, we experienced that it was not always correlated well with the outcome of such patients. With this back ground, we undertook a study involving the patients with rheumatic mitral stenosis in NICVD, Dhaka, Bangladesh, to evaluate the echo parameters which favorably affect the outcome of PTMC in these patients.

1. *Dr. Md. Shahriar Kabir, Assistant Professor of Cardiology, Dinajpur Medical College, Dinajpur, Bangladesh.*
2. *Dr. Abdullah –Al- Shafi Majumder, Professor of Cardiology, NICVD, Dhaka, Bangladesh*
3. *Dr. M Saiful Bari, Associate Professor of Cardiology, Dinajpur Medical College, Dinajpur, Bangladesh*
4. *Dr. Abdul Wadud Chowdhury, Associate Professor of Cardiology, NICVD, Dhaka, Bangladesh.*
5. *Dr. AEMM Islam, Assistant Professor of Cardiology, Dhaka Medical College, Dhaka*
6. *Dr. Shaikh Md. Shahidul Haque, Assistant Professor of Cardiology, Dinajpur Medical College, Dinajpur, Bangladesh.*
7. *Dr. Pijush Kanti Sarma, Senior Consultant, Department of Cardiology, Dinajpur Medical College hospital, Dinajpur, Bangladesh*

**For correspondence*

Methods

Study design: Prospective observational study.

Place and period of study: National Institute of Cardiovascular Diseases (NICVD), over 2000-2004.

***Study Population*:** This study was performed on 300 patients of symptomatic mitral stenosis who underwent PTMC in NICVD.

***Inclusion criteria*:** All the patients were included in this study after obtaining informed written consent. The selection of the patients were based on the following criteria-

a) Age- unrestricted
b) Sex- either sex
c) New York Heart Association (NYHA) class III or IV dyspnoea
d) Patients having symptomatic mitral stenosis with mitral valve area < 1.5 cm^2 and total echocardiographic score < 10
e) Patients with re-stenosis after closed mitral commissurotomy having favourable mitral valve morphology.

***Exclusion criteria*:**

a) Patients having mitral stenosis with mitral regurgitation ≥ grade II
b) Total echo score ≥ 10
c) Patients having other significant valve lesions requiring surgical treatment.
d) Evidence of left atrial thrombus.
e) Patients with associated congenital heart diseases, e.g. atrial septal defect (ASD)
f) Patients having contraindication to trans-septal puncture, e.g. very thick IAS, aneurysm of inter atrial septum, etc.
g) Patients with significant renal impairment.

Procedure: PTMC was done with all aseptic precaution through femoral venous approach under local anaesthesia. Pressure in aorta, LV and PA was recorded, and LA/LV gradient was calculated. A simple balloon sizing method based on body height for selection of appropriate size balloon catheter was used:

$$\text{Balloon size (mm)} = \frac{\text{Height (cm)}}{10} + 10$$

Post-procedural evaluation: 2-D, M-mode, PW, CW Doppler and color flow imaging were done 24 to 72 hours after PTMC to evaluate all echocardiographic parameters which were taken before the procedure. Successful procedures were defined as increase in mitral valve area (MVA) > 1.5cm^2 or > 50% increase in pre-procedural MVA or ≥50% reduction in trans-mitral pressure gradient. Complications like cardiac tamponade, mitral regurgitation, and acute pulmonary edema were recorded.

Results

Table I shows most of the patients were female and majority of the patients (>76 %) were 20-29 years old. Demographic characteristics of the patients are shown in the Table II. Mean BMI in male was 18.8 ± 3.5 and in female was 17.2 ± 2.7. Table III shows NYHA class distribution of study population; most of the patients (69.7%) were in class III. Table IV shows base line echocardiographic variables of the patients before PTMC which include mitral valve area, peak and mean pressure gradient; PASP and left atrial diameter. Table - V shows NYHA class distribution before and after PTMC; most of the patients in class III NYHA were reverted to class II and I after procedure; majority NYHA class IV patients were reverted to class II and III. Table VI shows distribution of Wilkin's echocardiographic score of mitral valve morphology among the patients and post PTMC outcome.

Table I: Age and sex distribution of the patients (N = 300)

Age (Year)	Sex		Total
	Male	Female	
<20	5	3	8
20-29	40	81	121
30-39	25	83	108
40-45	15	48	63
Total	85	215	300

Table II: Demographic Characteristic of the study population (N=300)

Variable	Male (Mean ± SD)	Female (Mean ± SD)
Height (cm)	156.4 ± 8.2	151.0 ± 7.3
Weight (Kg)	46.3 ± 8.5	42 .0 ± 6.2
BMI (Kg/m^2)	18.8 ± 3.5	17.2 ± 2.7

Table III: New York Heart Association (NYHA) class distribution among the patients before procedure (N= 300)

NYHA class	NO (%)
III	209 (69.7)
IV	91 (30.3)

Table IV: Baseline echocardiographic variables of the patients before procedure (n = 300)

Variable	Mean ± SD
Mitral valve area (cm^2)	
Planimetry method	0.9 ± 0.2
Pressure half time method	0.9 ± 0.2
Peak pressure gradient (PPG, mm Hg)	23.7 ± 5.1
Mean pressure gradient (MPG, mm Hg)	18.7 ± 5.2
Pulmonary artery systolic pressure (PASP, mm Hg)	51.8 ± 17.2
Left atrial diameter (LAD, mm)	43.3 ± 7.3

Table V: NYHA class distribution among the patients before and after procedure (N = 300)

Before Procedure		After procedure	
NYHA class	Frequency	NYHA class	Frequency
Class III	209	Class IV	1
		Class III	8
		Class II	140
		Class I	60
Class IV	91	Class IV	3
		Class III	19
		Class II	68
		Class I	1

Among the 4 parameters of Wilkin's score only subvalvular changes and valvular calcification have significant impact on technical success of PTMC. More the subvalvular changes and calcification less the chance of technical success. Table VII shows distribution of Wilkin's echocardiographic score of mitral valve morphology and post - PTMC complication. The frequency of complications were more in patients having higher subvalvular changes and valvular calcification. Table VIII shows post PTMC outcome in patients with different mitral valve area. The frequency of technical success in patients having MVA <1cm^2 and ≥1cm^2 is not significantly different. Table IX shows post PTMC complications in patient having MVA <1cm^2 and ≥1cm^2; complication rate is not significantly different between the two groups.

Discussion

Percutaneous balloon mitral commissurotomy (PTMC) has become a very popular technique over time, for selected patients with moderate to severe mitral stenosis, since the introduction of the procedure by Inoue et al. in 1984.[1] The procedure involves passing a balloon catheter from the right atrium through the interatrial septum into the left atrium and then across the stenotic mitral valve into the left ventricle. Inflation of the balloon

mechanically splits the fused commissures. Remarkable success and fewer complications led the procedure to be popular so much so that within 12 years of its introduction over 30,000 patients underwent PTMC worldwide.[2] The immediate haemodynamic results are comparable with the results of closed or open mitral valvuloplasty.[3,4] Successful PTMC is defined as an increase of mitral valve area (MVA) to or over 1.5 cm^2 or an increase of MVA $\geq$ 50 % over pre-PTMC MVA or $\geq$ 50% reduction in transmitral pressure gradient and no more than grade II mitral regurgitation.[5] Class I indication for PTMC includes those symptomatic patients (NYHA functional class II, III, or IV) with moderate or severe mitral stenosis (mitral valve area $\leq$ 1.5 cm^2) and valve morphology favorable for percutaneous balloon valvotomy in the absence of left atrial thrombus or moderate to severe mitral regurgitation.[5]

There is ongoing debate and research on the major predictors of outcome of PTMC in patients with mitral stenosis. Patient's age, sex, clinical factors like NYHA functional class; co-morbid conditions like renal or hepatic impairment; echocardiographic variables like leaflet mobility, leaflet thickening, valvular calcification, subvalvular

Table VI: Distribution of Willkin's echocardiographic score of mitral valve morphology among the patients and post – PTMC outcome (N=300)

Parameter	Frequency	Technical success (MVA $\geq$ 50 % over pre-PTMC MVA)	P-value
Leaflet Mobility			
1	10	10	
2	260	241	NS
3	30	27	
Leaflet Thickness			
1	11	10	
2	263	243	NS
3	26	25	
Sub valvular Change			
1	37	36	
2	207	200	<0.05
3	56	42	
Valvular Calcification			
1	204	202	
2	69	60	<0.05
3	27	16	
Total Echo score			
1-6	254	252	<0.05
7-9	46	26	
Total	300	278	

Table VII: Distribution of Willkins echocardiographic scores of mitral valve morphology and post-PTMC complications. (N= 300)

Parameter	Frequency	Complications of PTMC		P Value
		MR ≥Gr II	Pulmonary oedema	
Leaflet Mobility				
1	10	1	0	
2	260	17	2	NS
3	30	2	0	
Leaflet Thickness				
1	11	1	0	
2	263	18	1	NS
3	26	1	1	
Subvalvular Change				
1	37	0	0	
2	207	3	0	<0.05
3	56	17	2	
Valvular Calcification				
1	204	5	0	
2	69	5	1	<0.05
3	27	10	1	
Total Echo score				
1-6	254	3	1	<0.05
7-9	46	17	1	

Table VIII: Post-PTMC outcome in patients with different mitral valve area (MVA) N = 300)

MVA Technical	Frequency	Success-No (%)	P-value
< 1 cm^2	194	179 (92.3)	>0.05
$\geq$ 1 cm^2	106	99 (93.4)	>0.05

Table IX: Post-PTMC complications in patients with different mitral valve area (MVA) N= 300

MVA Technical	Frequency	No. of patients with complications	P-value
$< 1\ cm^2$	194	14	>0.05
$\geq 1\ cm^2$	106	8	>0.05

changes, associated mitral regurgitation or other valve involvement; Initial haemodynamic variables like pulmonary artery pressure and resistance, cardiac output, pre-dilatation trans-mitral gradient; etc may be the factors which can positively or negatively affect the outcome in these group of patients.

Our study is concerned only with the echocardiographic variables which influence on the outcome of PTMC. Although the primary structural feature that determines the haemodynamic severity of mitral stenosis is the mitral valve orifice, the size of the orifice was in no way predictive of the outcome of PTMC. Patients with smaller valve areas over the range studied were just as likely to have an optimal result as those with larger valve areas before the procedure. This observation is consistent with that of Wilkins et al.[6]

We performed conventional two-dimensional echocardiography to evaluate the echocardiographic variables. Higher echo score was associated with more suboptimal outcome and more complications; lower echo score was associated with more optimal technical success and fewer complications (table VI & VII). This observation is statistically significant (P-value < 0.05). Wilkins et al. also observed similar result in their study involving 22 patients shortly after the introduction of the PTMC procedure.[6]

We gather a newer experience through our study regarding the individual component of total echo scoring. So far, the factor which could be considered to be the single most important factor in relation to the outcome of PTMC is total echo scoring, which express the combined assessment of leaflet mobility, valvular thickening, subvalvular changes, and leaflet calcification.[6] Our study shows that among the four echocardiographic variables only the two, subvalvular changes and leaflet calcification, negatively affects the technical success and are also associated with more complications. Increasing grades of valvular calcification and subvalvular changes significantly reduce the outcome of the procedure and increase the complications (Table VI & VII). Whereas, the current study shows no significant association of leaflet mobility and thickness with either technical success or complications of the procedure (Table VI & VII).

Therefore, what we can do to determine the management option of patients with moderate to severe mitral stenosis that is only to consider subvalvular changes and valvular calcification ignoring the total echo score and also the leaflet mobility and thickness. Real-time three-dimensional echocardiography is a better option for evaluating echocardiographic variables more precisely.[7] But, we had to depend on conventional two dimensional echocardiography for this purpose. More positive outcome and fewer complications could be expected if patients were selected for the procedure with this newer technology.

Although we were not concerned with factors other than echocardiographic variables which can affect the outcome of PTMC, we must sort for other parameters and co- morbidity to have more positive results of the procedure. The echocardiographic score may not correlate well with age and also they have more chance of having co-morbid cardiac

conditions. As a result, older patients may have less good outcome with catheter balloon commissurotomy.[8]

Dobutamine stress echo may predict clinical events and help in selecting those patients with symptoms out of proportion to the severity of their calculated mitral valve area who will most probably benefit from an intervention that may be either medical or invasive.[7, 9]

Study Limitations

The echocardiographic analysis presented in this study is based on a qualitative assessment of the mitral valve and apparatus. So, there may have a chance of inter and intra-observer variation in the assessment. This can be overcome to a great extent by using real time three dimensional echocardiography.

Older patients were excluded from the study for either their co-morbidity or denial of the procedure. As a result, outcome of the procedure could not be assessed in the elderly patients.

Conclusion

It is a compulsory but a difficult task to select those patients with mitral stenosis who will be best benefited by PTMC without any or fewer procedure related complications. So far the echocardiographic variables are concerned, subvalvular changes and valvular calcification can be regarded as the most important factors to be evaluated appropriately for the best outcome of the procedure.

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