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Percutaneous Mitral Commissurotomy in Patients with Calcific Mitral Stenosis

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Abstract—**Objective: the study evaluated the clinical and echocardiographic data, before and after percutaneous mitral commissurotomy (PMC) in patients with calcific mitral stenosis. Materials and methods: this is a retrospective study of 215 patients divided into two groups: 148 patients with calcific mitral stenosis (Group 1), and 67 patients without mitral calcifications (Group 2). The study period is between January 2011 to July 2015.Results: the group 1 was significantly older than the group 2 (49,7±12,2 (group 1) versus 42,7±12,8(group 2) , p<0,001), and had significantly more men than women (female gender:75% in group 1 vs.88,1% in group 2, p<0,05). Before PMC: group 1 had significantly higher Wilkins (9,3±0,8(group 1) vs. 8,5±0,6 (group 2) p <0,001) and smaller mitral valve area (0,91±0,20 (group1) vs.0,99±0,20 (group 2), p<0,05). After PMC: the final valve area was significantly smaller in patients with, than, without calcifications (2,10±0,26 vs.2,20±0,22 p<0,05). However , the rate of good immediate results, defined as valve area ≥1,5 cm² with no mitral regurgitation >2/4 (97,9%vs.100% , p> 0,05), and the rate of post PMC mitral regurgitation (MR≥3/4) (2% vs.0% , p>0,05), were no different between the 2 groups.Conclusion: PMC can be used for the treatment of patients with calcific mitral stenosis safety, with good immediate results.**

Index Terms—**Calcification, Echocardiography,Percutaneous mitral commissurotomy, Mitral stenosis.**

I. Introduction

The mitral valve stenosis is the most acquired common valvular disease in the countries in development [1,2]. Since its introduction in 1984 by Inoue, the percutaneous mitral commissurotomy (PMC) has become an effective and durable procedure to treat patient with mitral stenosis [3]. Today PMC is considered the first line treatment for symptomatic patients with favorable anatomy [4, 5].However, therapeutic decision is discussed when the mitral valve stenosis is calcified, and some studies have reported a lower PMC success rate and more frequent post procedural severe mitral regurgitation (MR) in patients with mitral valve calcification [6]. The aim of our study is to assess the immediate outcome of PMC in patients with calcific mitral stenosis.

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II. Materials and Methods

This is a retrospective study included 215 patients with mitral valve stenosis , who underwent a PMC between January 2011 and July 2015 at cardiology department A in IbnSina hospital, Rabat Morocco. All of them had transthoracic echocardiography before and after PMC, and a transoesopagic echocardiography before this procedure. Exclusion criteria for PMC were severe bilateral commissural calcification, more than mild mitral regurgitation and left atrial thrombus. Echocardiography was performed just before and 24–48 h after the procedure by experienced operators. Mitral valve area (MVA) was measured by 2-dimensional echocardiography in parasternal short-axis view (planimetry). Mean transmitral gradient was assessed by continuous wave Doppler. Measurement of systolic pulmonary artery pressure was based on the maximal velocity of the tricuspid regurgitation. Mitral regurgitation was semi-quantitatively graded from 0 to 4. After PMC, the 'degree of commissural opening' was semi-quantitatively evaluated as none, partial (up from only several millimetres from the valve orifice), or complete (up to the level of the mitral annulus) in parasternal short-axis view. Mitral valve calcification was defined using transthoracic echocardiography as bright areas with acoustic shadowing. The degree of calcification was independently scored. Patients were divided into two groups: Group1 with calcific mitral stenosis (MS) and Group 2 with non-calcific MS. PMC was performed by antero-grade trans-venous approach using the Inoue balloon with stepwise inflation showed by echocardiography; balloon size was depending to patient's height and the balloon was inflated in steps of 1–2 mm. Valve area (planimetry), mean transmitral gradient, commissural splitting, and the degree of MR were assessed by transthoracic echocardiography after each inflation. Our criteria for stopping the procedure were complete opening of at least one commissure with a valve area at 1.5 cm2 or the occurrence or increase of regurgitation. A good immediate result was defined as a good valve opening (final valve area≥1.5 cm2) with no regurgitation.;Quantitative variables were expressed by mean ± standard deviation and compared by T-test. Qualitative variables were expressed by percent and compared by Chi-2 test or Fisher test. Statistic is significant by p<0, 05.

III. RESULTS

Mean age was 47±12 years and 79, 5% were female. Most of patients were symptomatic and 60% had atrial fibrillation, 18, 6% had a previous commissurotomy (either surgical or percutaneous).Clinical and echocardiographic characteristics of patients are presented in Table 1. 148 patients had a calcific mitral stenosis (group1) and 67 patients without mitral calcification (group2) .Group 1 was significantly older than Group 2 (49,7±12,2 versus 42,7±12,8, P<0,001), and had significantly more men than women.(female gender 75% in group 1 Vs 88,1% in group 2, P<0,05).The incidence of previous commissurotomy was similar into the two groups(24,3% vs11,9% P=0,78).Before PMC, Group 1 had significantly higher Wilkins score (9,3±0,8(group 1) vs.8,5±0,6 (group2), p <0,001) , tight mitral valve area (MVA) (0,91±0,20 (group1) vs.0,99±0,20 (group 2), P<0,05)and higher mean gradient (15,81±4,8

The incidence of atrial fibrillation was significantly less frequent in group 2 than group 1. Systolic pulmonary artery pressure was significantly higher in group 1 than group 2. After PMC; The mitral valve area was increased; 2,10±0,26 in group 1 vs.2,20±0,22 in group2 (P<0,05) and pulmonary pressure was decreased 31,89±13,35 in group1 vs35,97±9,97 in group 2(P=0,026); however the MVA increase was similar into the 2 group (1,19±0,25 vs 1,19±0,25 P =0,946).Concerning the final mean gradient , there was no significant difference between two groups. The rate of good immediate results was similar into two groups(97,9% vs.100% .P=0,241).There was no death , one case was presented a tamponnade, a moderated mitral regurgitation was observed only in 4 patients of group 1 , but without significant difference.(2% in group 1 vs 0% in group 2 .P=0,174) .

Table I: Baseline clinical and echocardiographic characteristics of the population, overall and according to subgroups

	ovrall (n=215)	Group 1 (n=148)	Group 2(n=67)	*P*
Age (years)	47,53±12,81	49,70±12,23	42,76±12,85	*P*<0,001
Female gender	79,5%(171)	75%(70)	88,1%(59)	*P*=0,03
NYHA functional class III–IV	97,2%(209)	95%(142)	95,6%(64)	*P*=0,66
Previous commissurotomy	18,6%(40)	24,3(36)	11,9%(8)	*P*=0,78
Atrial fibrillation	60%(129)	66%(99)	44,8%(30)	*P*=0,002
Wilkins score	9,13±0,88	9,38±0,85	8,52±0,63	*P*<0,001
Mitral valve area (cm2)	0,93±0,20	0,91±0,20	0,99±0,2	*P*=0,01
Mean gradient (mmHg)	15,33±4,59	15,81±4,87	14,28±3,7	*P*=0,023
Systolic pulmonary artery pressure (mmHg)	57,13±17,31	58,84±17,92	53,66±15,37	*P*=0,031

Table II :Results of percutaneous mitral commissurotomy overall in the 215 patients, and according to subgroups

	Overall (n=215)	Group 1(n=148)	Group 2(n=67)	*P*
echocardiographic characteristics				
Mitral valve area (cm²)	2,13±0,26	2,10±0,26	2,20±0,22	*P* =0,012
Mitral valve area increase (cm²)	1,19±0,25	1,19±0,25	1,19±0,25	*P* =0,946
Good immediate results (SM>1,5 et IM<2)	98,6%(212)	97,9%(145)	100%(67)	*P*=0,241
Mean gradient(mmHg)	5,14±1,88	5,30±1,96	4,78±1,63	*P*=0,059
Mean gradient increase (mmHg)	10,18±4,33	10,50±4,49	9,49±3,91	*P*=0,116
Systolic pulmonary artery pressure, (mmHg)	33,16±12,52	31,89±13,35	35,97±9,97	*P*=0,026
Systolic pulmonary artery pressure increase (mmHg)	23,97±12,67	26,95±12,32	17,39±10,87	*P*<0,001
Bilateral complete commissural opening	72,5%(156)	69,6%(103)	79,1%(53)	
At least one commissure completely open	27,4%(59)	30,4%(45)	20,9%(14)	
In-hospital complications				
In-hospital mortality	0%	0%	0%	
Tamponade	0,4%(1)	0%	1,5%(1)	
Embolism	0%	0%	0%	
Mitral regurgitation grade ≥3	1,8%(4)	2%(4)	0%	*P*=0,174
Mitral valve replacement	0,4%(1)	0,6%(1)	0%	

IV. DISCUSSION

Percutaneous mitral commissurotomy is now emerging as treatment at the first-line of mitral stenosis with favorable valvular anatomy, with good immediate results which are maintained in the medium and long term [7]. However, few studies have examined the feasibility and effectiveness of PMC for calcific mitral stenosis [8]. Our study describes characteristics and compares results of PMC of calcific mitral stenosis (MS) to mitral stenosis without calcifications.

Calcific MS is observed in older population than MS without calcifications; Indeed, in our study, the mean age of patients with calcific MS was 49, 7±12,2 vs.42,7±12,8. This age difference is also found in Murat Tuzcu study when the mean age is 61 years in calcific MS vs 47 years [9] ,and in Iung study when the mean age is 58 ±13 years vs 45 ±15 years respectively [10], and in the Kurudamannil study; 46,2±10,3 years of calcific MS [11]. Although age is as an important factor involved in development of mitral calcification, male gender was cited as predisposing factor of calcifications [12], even if female gender is frequent, in our study, there are significantly more men in calcific MS group 1 compared to group 2. This greater proportion of men was also seen in Murat Tuzcu study (143women/30 men for MS without calcifications vs.124 men/31women for calcificMS.)[9]

Moreover, atrial fibrillation usually funded in patients with calcific MS, 66% of our patients with calcific MS were in atrial fibrillation versus 44.8% in the group of MS without calcifications. We found also this difference in the literature; in Iung study (50% had AF in calcific group MSvs 33% in the no calcific MS group), and Tuzcu study (64% had AF in calcific MS group vs 35%in no calcific MS group)[9,10)]. Atrial fibrillation is more frequent because the patient are older, with MS tighter and a left atrium more dilated [10].Wilkins score was significantly higher in calcific MS group versus non- calcific MS Group, it's logical because the degree of calcification is one of 4 criteria of score but also the high degree of calcification is associated to valvulargreater thickness, reduced valve mobility and relatively severe extent of subvalvular disease [13]. In Murat Tuzcu study, the Wilkins score was 8, 9 in calcific MS group versus 6, 8 in no calcific MS group [9].

Mitral stenosis was more severe in our patients compared to no calcific MS group, with a high percentage of mitral stenosis very tight (mitral area < 1 cm²): ²); 53,3% versus 32,8%; like MuratTuzcu study: 0,8cm² for calcific MS vs 0,9cm² in control group[9]. Mitral stenosis is tighter even the degree calcification is high, according to Julien Dreyfus study where there had a highly significant difference between the three sub- groups studied (p <0.0001); mitral area at 1,09cm²in group with MS without calcifications, MA at 1,05cm² in group with no significant commissural calcification, and MA at 0,95cm²in group with significant commissural calcification[3]. We conclude that calcific MS affects older patients, often in atrial fibrillation and mitral stenosis is tighter with altered valves .A good result is defined by combination of a mitral functional surface ≥ 1.5 cm ² and a small mitral regurgitation (MR). In our study, the rate of good immediate results was very good: 97.9%, below the rate of success in non-calcific MS group is 100 %, there is no significant difference. This success rate is less important in other studies treating calcific MS; It was 79% in Iung study and 85.4% in kurudamannil study [10, 11]. Indeed , PMC during the first 10 years of experience ,as our study has been done on calcific MS dilated from 2011 to 2015 , so after 25 years of experience in our department. Furthermore, the listing of calcifications was not the same in our study compared to other studies, we have classified calcifications by tranthoracic and trans oesophagicechocardiograpy while the authors were based on visualization of calcifications by fluoroscopy and angiography [10,11,14]. Moreover, the success rate was significantly lower in Tuzcu study compared to our results and those of other studies; 52% in calcific MS group, This low success rate is partly due to the difference in the definition of a good immediate result for Tuzcu , unlike other authors, the appearance of significant MR grade was a failure criterion[9].

Table III :Comparison of immediate results of PMC of calcific MS with those of the literature.

Studies	Number of patients	Age	Wilkins score	Mitral valve Area (cm²)		Rate of success (%)	MR aggravation≥3 (%)
				Before	After		
TUZCU 1994 [9]	155	61±1	8,9±0,2	0,8±0,02	1,8±0,06	52	
IUNG 2000[10]	422	58±13		1,01±0,22	1,74±0,30	79	4
KURUDAMANNIL 1999[11]	41	46,2±10,3	9,2±0,9	0,9±0,2	1,7±0,3	85,4	2,4
Our study (between 2011-2015)	148	49,7±12,2	9,3±0,8	0,91±0,20	2,10±0,26	97,9	2

MVA after PMC was more higher in patients with a Wilkins score<8 (2,21 cm²), than patients with a score between 9 and 11 (2,09cm²). The study of individual parameters of this score shows that immediate result of PMC is strongly influenced by degree of valvular mobility, and by association of calcifications [13]. However, a major limitation of Wilkins score is the lack of study of commissure morphology. The main mechanism of action of PMC is separation of the fused commissure; including the presence of significant fibrosis or calcifications commissure, will constitute a failure of the procedure factor. In Bezdah study: commissure morphology has significantly influenced the result of PMC: MVA was 1,83cm² with no commissural calcifications, and dropped to 1,5cm² when commissure was calcified [13].

PMC safety, and immediate as well as long-term efficacy have been widely demonstrated [15]. PMC remains a safe procedure, which does not expose patient to increased risk of complications. But it must still emphasize a trained and experienced operator, especially when there is a highly calcified valve. In our study, no deaths were directly induced by the procedure, one case of tamponade in no calcific MS group. The mortality in the literature, although it is slightly higher compared to our study , remains below 2%(in Iung study; 1,2% with a tamponade in 0,5% of cases ; in Murat Tuzcu study; 1,9% with a cardiogenic shock, a tamponade and a perforation of the left ventricle)[9,10] . We deployed no cases of thromboembolism in our study. In theory, the presence of calcifications fears in per- procedure migrating calcareous emboli and the occurrence of stroke, this has not been demonstrated [10,14,15].Mitral regurgitation is a serious and feared complication of CMP. In our study: 4 cases of severe MR in calcific MS and no cases in no calcific MS group; Iung had 4% of severe MR[10], and kurudamannil had 2,4% of severe MR[11].

Several predictors of MR were analyzed by echocardiography[16,17].In fact, Padial LR has also established a Risk Score occurrence of MR (Mitral regurgitation echoscore) integrating study of thickening valve , distribution of fibrosis and calcifications in each leflets , the study of commissures and the extent of subvalvular disease. This score is more difficult to study than Wilkins score, proved superior in predicting occurrence of severe MR[18,19].

V. Conclusion

Percutaneous mitral commissurotomy must be indicated as first-line treatment of patients with calcific mitral stenosis(Grad 1,2,3), because the results in this group was similar to the group without calcifications. So though our experience and in our context ,The PMC of patients with calcific mitral stenosis allow us to the management of patients with a difficult socio-economic status, who don't have access to the surgery . Prospective studies would better understand the predictors of immediate and long-term results of the PMC in the calcific MS, for a better selection of patients.

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