PERCUTANEOUS TRANSSEPTAL BALLOON MITRAL VALVOTOMY: INITIAL EXPERIENCE IN SINGAPORE

C N S Chan, A T H Tan, T H Koh, T S Chee, Z P Ding

ABSTRACT

Between June 1990 and August 1991, 28 percutaneous transseptal balloon mitral valvotomy procedures were attempted in 27 patients (23 women and 4 men; mean age 39.8±9.3 years) with severe mitral stenosis. Successful mitral valvotomy was achieved in 25 patients (primary success rate of 92%). Mitral valve area increased from 0.82±0.17 cm² to 1.53±0.48 cm² (p<0.001) and the mean mitral valve gradient decreased from 13.4±7.4 to 6.0±5.4 mmHg (p<0.05).

There were no deaths, one patient had cardiac tamponade after transseptal puncture and required emergency pericardiocentesis with successful percutaneous balloon valvotomy 6 months later. One patient had an unsuccessful valvotomy because the mitral valve could not be crossed and another patient had an inadequate dilatation. Our initial experience in percutaneous transseptal mitral valvotomy confirms the safety and efficacy of this new technique for the treatment of rheumatic mitral stenosis.

Keywords: *percutaneous balloon mitral valve commissurotomy*

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INTRODUCTION

Since its introduction in 1984 by Inoue[1], percutaneous balloon mitral valvotomy (PBMV) has emerged as an alternative to surgical management of mitral stenosis for properly selected patients. This procedure has gained worldwide acceptance as an effective technique to perform mitral commissurotomy by a less invasive action. The purpose of this paper is to present the immediate results of PBMV performed at Singapore General Hospital.

METHODS

Study Population

Between June 1990 and August 1991, 27 patients with rheumatic mitral stenosis had PBMV. There were 23 women and 4 men, their ages ranged from 25 to 60 years (mean 39.8±9.3 years). Fourteen patients were in NYHA Class III, 13 in Class II; 16 patients were in sinus rhythm and 11 is atrial fibrillation. Only one patient had previous open mitral commissurotomy.

Study Protocol

The criteria for PBMV in our institution include (i) the presence of isolated mitral stenosis or with no significant mitral regurgitation (less than grade 3), (ii) the absence of left atrial thrombus, (iii) the mitral valve leaflets should be pliable and without severe calcification or associated severe subvalvular disease.

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Echocardiography

Transthoracic and transesophageal Doppler echocardiography were performed in all the patients before PBMV to assess the mitral valve morphology and to exclude the presence of left atrial thrombus. Each patient was graded according to the method used by Wilkins et al ie the degree of leaflet mobility, leaflet thickening, calcification and subvalvular disease[2]. Each criterion was graded on a scale of 1 to 4 and the sum of all scores was calculated for each patient (Table I). A patient was considered a good candidate for PBMV if the total score is less than 8. Post PBMV, echocardiography was repeated one or two days after to assess the mitral valve orifice, to detect atrial shunts and severity of mitral regurgitation if present.

Table I - Echocardiographic score of study population

Echo Score	No of patients
4	1
5	0
6	7
7	10
8	6
9	3

Technical Aspects of PBMV

The procedure is performed under local anaesthesia at the femoral puncture sites. Oral anticoagulants were stopped 5 days before the procedure. Of the 28 procedures attempted, 20 were performed with the Inoue balloon and 7 with the double balloon technique. One procedure was abandoned after cardiac tamponade occurred during transseptal puncture.

Double balloon technique

Right and left heart catheterisation are done using the femoral approach by the modified Seldinger technique. A Swan-Ganz catheter is placed in the pulmonary artery and a 7F pigtail in the left ventricle. Cardiac output was measured by thermodilution method and the mitral valve area was calculated by the Gorlin's formula. Left ventriculogram is performed biplane to show the position of the mitral valve apparatus and to evaluate the severity of mitral regurgitation if present. Transseptal catheter together with the Mullin's sheath was introduced in the right femoral vein. Transseptal puncture of atrial septum was performed biplane ie anteroposterior and lateral position. Following successful puncture, 2,000 i.u. heparin was given. The Mullin's sheath was manipulated into left ventricle. Two 0.038" 260-cm long exchange guide wires are positioned at the apex of left ventricle. The interatrial septum was dilated with a 8-mm balloon catheter, followed by the femoral vein before the passage of larger balloons for the mitral valve. The two balloons (Mansfield) are positioned across the mitral valve and inflated simultaneously until the waist disappeared (Fig 1 & 2). Simultaneous pressures in the left ventricle and pulmonary wedge are recorded to assess the result of the dilatation. Finally, the cardiac output and mitral valve area are calculated and left ventriculogram and oximetry run are performed.

Fig 1 - Double balloon technique, balloons partially inflated and arrow points waisting at mitral valve commissures.

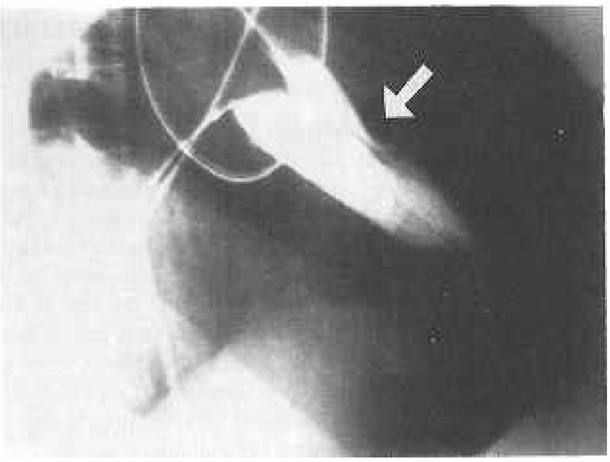
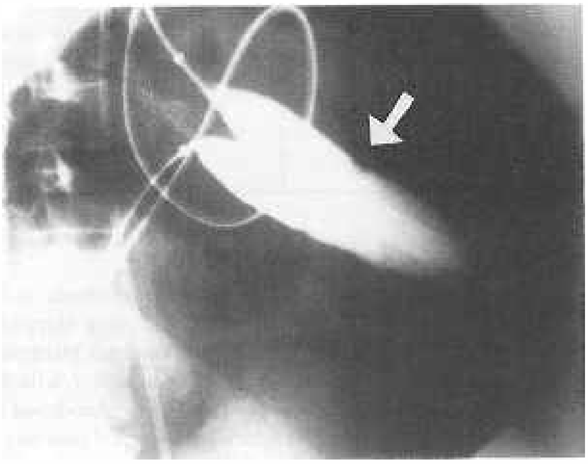


Fig 2 - Double balloon technique; balloons fully inflated and arrow points to separation of mitral commissures.



Inoue balloon dilatation

In the Inoue technique, a stainless steel guide wire was introduced through the transseptal catheter and its coiled tip was advanced into the left atrium. After the removal of the transseptal catheter, a long stiff dilator was advanced over the guide wire to dilate the interatrial septum before the Inoue balloon catheter was inserted. The mitral valve is then crossed with the balloon slightly inflated distally. Inflation is then performed at a predetermined volume and if suboptimal results occur, inflations are repeated with increased volumes (Fig 3 & 4).

Fig 3 - Inoue technique; balloon partially inflated and arrow points to severe waisting caused by fused commissures.

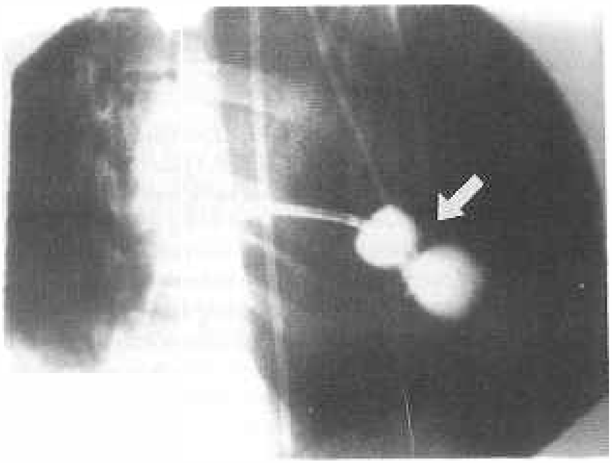
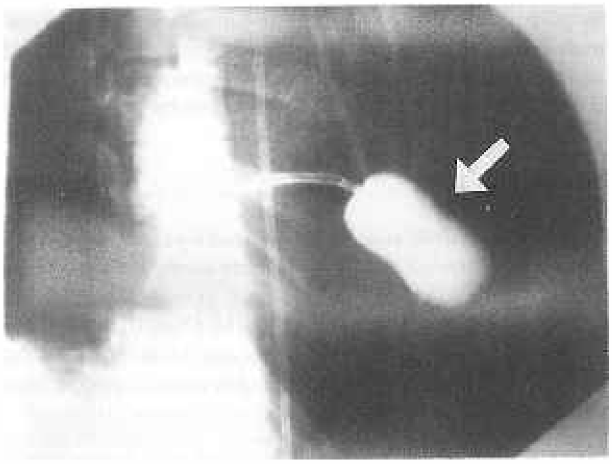


Fig 4 - Inoue technique; Inoue balloon fully inflated with disappearance of waisting of the balloon.



Statistics

All values were expressed as mean values ± one standard deviation. All variables before and after valvotomy were compared by the paired Student t test or the standard chi square test when appropriate. A p value <0.05 was considered as statistically significant.

RESULTS

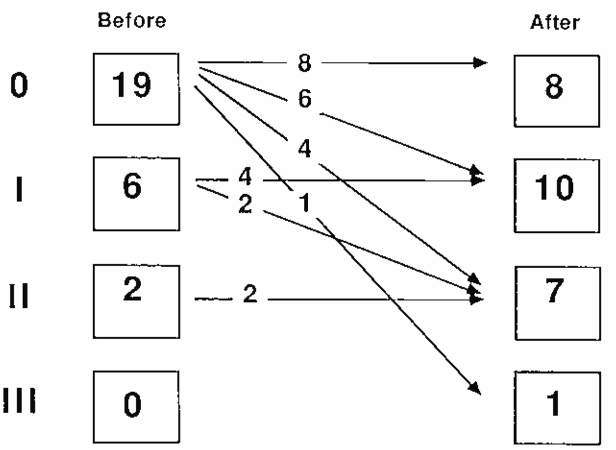
Of the 27 patients, 25 patients had a successful PBMV. In one patient, the procedure was discontinued because of the occurrence of haemopericardium after transseptal puncture. The patient underwent a successful PBMV 6 months later. Two patients had an unsuccessful PBMV: one patient because it was not possible to cross the stenotic mitral valve by the Inoue balloon catheter; the other patient because of inadequate dilatation of the mitral valve due to the presence of subvalvular disease. There was a marked decrease in the mean mitral valve gradient from 13.4 ± 7.4 to 6.0 ± 5.4 mmHg ($p<0.05$) and a concomitant increase in the mitral valve area from 0.82 cm^2 ± 0.17 to 1.53 cm^2 ± 0.48 ($p<0.001$) after PBMV as shown in Table II.

There was no severe mitral regurgitation as a result of PBMV. A regurgitation was created in 11 patients who had no mitral regurgitation initially, of grade 1 in 6 cases, of grade 2 in 4 cases and of grade 3 in one case. A pre-existing grade 1 regurgitation was present in 6 patients; 4 remained unchanged while 2 increased by one grade only. Two patients with grade 2 regurgitation showed no increase after dilatation (Fig 5). Echocardiography detected an atrial shunt in 7 patients but oximetry measurements confirmed that they were not significant.

Table II - Haemodynamic parameters before and after Valvuloplasty

	Before PBMV	After PBMV
Mitral mean gradient (mmHg)	13.4±7.4	6.0±5.4
Mitral valve area (cm²)	0.82±0.17	1.53±0.48

Fig 5 - Mitral Regurgitation



Complications

In one patient, cardiac tamponade occurred after transseptal puncture. The patient was managed conservatively after pericardiocentesis and had a successful PBMV six months later. Transient hypoxic fits occurred in two patients during dilatations with the two balloons technique with no adverse sequelae. Two patients required blood transfusion after the procedure due to bleeding in the femoral puncture sites.

DISCUSSION AND REVIEW OF THE LITERATURE

The basic pathology of rheumatic mitral stenosis is the fusion of the commissures which reduces the effective opening valve orifice[3]. This can be easily corrected by a balloon inflation which produces a dilating force to separate the commissures and hence increasing the valve orifice, a mechanism similar to surgical closed commissurotomy. Association of other pathologic processes such as leaflet thickening, calcification and fusion and shortening of the chordae tendinae are already known to be major determinants of poor results in surgical mitral commissurotomy[4,5]. It is not therefore surprising that the same determining factors give a suboptimal result in balloon mitral valvuloplasty. We have used echocardiography to select our patients for PBMV and only 3 patients had a echo score >8 (Table I). Long term results and particularly the restenosis rate, are still unknown due to the relatively recent introduction of the procedure. However, recent reports of follow up of 1 to 3 years after PBMV suggest that the initial benefits obtained after PBMV were still maintained[6-9] and are comparable to those of surgical closed commissurotomy.

The early results in our series are very encouraging with a procedural success rate of 92% which is comparable to the experience in other centres[9-11]. There were no deaths in our series and few complications. Perforation of the left atrial wall resulting in cardiac tamponade occurred in one patient early in our experience and this is probably due to the learning process of transseptal puncture. Creation of a severe mitral regurgitation is a recognised complication but did not occur in our experience. However we have encountered ≥ 2 grade regurgitation in five patients with no prior regurgitation in whom we have used the Inoue balloon catheter. This could be related to the geometry of the balloon catheter but our series is too small to draw any conclusion between the two techniques used. We have, however, noted that for the last 20 patients in whom we have used Inoue balloon, the procedure is shorter compared to the double balloon technique. As shown in other series, involvement of the subvalvular mitral apparatus is the most important factor for a good result of dilatation.

Hermann in evaluating patients by an echocardiographic score found that in patients with a score <8 (good subvalvular apparatus) the mean valve area increased from 0.9 ± 0.1 to 1.9 ± 0.1 cm² compared to patients with an echo score >8 (severely thickened subvalvular apparatus) the gain in valve area is less from 0.9 ± 0.1 cm² to 1.6 ± 0.1 cm²[4]. In our series, only one patient had an insufficient result after dilatation and she had a poor subvalvular apparatus.

It is of note that PBMV can be performed satisfactorily in patients who had a previous surgical mitral commissurotomy[12]. Only one of our patients had a previous surgical mitral commissurotomy and her mitral valve area increased from 0.8 cm² to 1.7 cm² after her procedure and her mitral regurgitation which was graded as II in severity did not worsen.

The wide acceptance of PBMV is justified because it produces an excellent opening of the fused mitral valve leaflets with a less invasive procedure, without requiring a thoracotomy, and allows patients to be discharged from hospital 24 to 48 hours after dilatation. The high cost of the balloon catheters will be a major limiting factor as surgical commissurotomy is relatively cheaper to the patient in Singapore.

In summary, we have demonstrated that PBMV can be effectively and safely performed at our institution in properly selected patients. More long term follow up is needed to determine the efficacy of this new technique.

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