Percutaneous balloon mitral valvuloplasty

Bernard D Prendergast, Stuart Shaw

Mitral stenosis is commonly encountered in the elderly and among immigrant communities. Percutaneous balloon mitral valvuloplasty provides effective treatment. The present article provides a brief overview of the principles of patient selection, technical details of the procedure itself and information concerning complications and follow-up.

Percutaneous balloon mitral valvuloplasty (PBMV) has been shown to be equivalent to open and closed surgical valvotomy and is now the procedure of choice for the treatment of patients with mitral stenosis and pliable valves. It may also be used as a palliative procedure in those who have a degenerative valve but are at high risk for mitral valve replacement (MVR).

WHO IS SUITABLE FOR THE PROCEDURE?

The patient

The principal indication is mitral stenosis producing symptoms despite medical treatment. PBMV may also be considered in mildly symptomatic individuals who desire an active lifestyle to help prevent paroxysmal atrial fibrillation and recurrent thromboembolism, and in asymptomatic patients developing severe pulmonary hypertension. The procedure can be performed in pregnant patients with mitral stenosis who are anticipated to develop heart failure before or during delivery. PBMV is not contraindicated by:

- Age
- Previous valvotomy
- Previous aortic valve replacement
- Co-existent impaired left ventricular function with or without coronary artery disease.

Since it is a percutaneous procedure performed under local anaesthetic, it may also be considered in the presence of co-existent non-cardiac disease which may contraindicate surgery, e.g. malignancy, chronic renal failure or cerebrovascular disease.

The valve

Echocardiography (*Figure 1*), including transoesophageal imaging, is an essential preliminary investigation for the assessment of valve morphology and the presence of associated mitral regurgitation or left atrial thrombus (*Table 1*). Balloon dilatation improves mitral valve area by commissural splitting and is unlikely to be successful when commissural calcification is seen

Figure 1. Transoesophageal echocardiogram (horizontal plane, four chamber view) taken from a patient with severe rheumatic mitral stenosis. Note calcification of the leaflets and spontaneous echo contrast within a grossly dilated left atrium, indicative of stagnant blood flow.

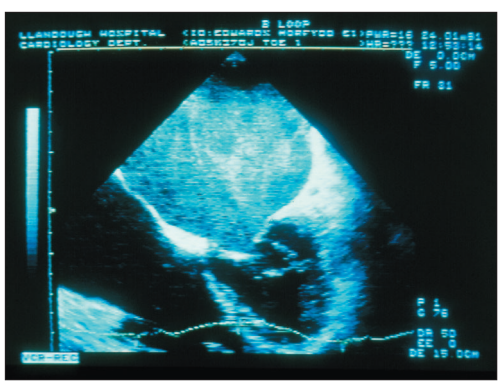


TABLE 1.
Echocardiographic assessment before balloon mitral valvuloplasty

Severity of mitral stenosis
Commissural fusion
Commissural calcification
Leaflet thickening/calcification
Subvalvular involvement
Associated mitral regurgitation
Left atrial thrombus
Atrial septal anatomy
Estimated pulmonary arterial pressure

Dr Bernard D Prendergast is Specialist Registrar in Cardiology and **Dr Stuart Shaw** is Consultant Cardiologist, Western General Hospital, Edinburgh

Correspondence to: Dr BD Prendergast, Consultant Cardiologist, Department of Cardiology, North-West Regional Cardiothoracic Centre, Wythenshawe Hospital, Manchester M23 9LT

at echocardiography. In the presence of leaflet rigidity as a result of marked thickening or calcification and when there is orifice tethering as a result of subvalvular disease, MVR is usually required. Nevertheless, PBMV can be a worthwhile palliative procedure in patients unable to undergo cardiac surgery.

Moderate or severe mitral regurgitation contraindicates the procedure. Thrombus protruding into the left atrial cavity (but not necessarily left appendicular or laminar thrombus) is a relative contraindication but may resolve after a 3-month period of intense anticoagulation.

HOW IS IT DONE?

Preparation is similar to that for routine cardiac catheterization (*Figure 2*). The patient is admitted the same day and fasted for 4–6 hours. The procedure is performed in the catheterization laboratory under local anaesthetic with or without sedation. General anaesthetic is occasionally necessary for anxious patients or those with severe orthopnea. Warfarin is withheld for 3–4 days before the procedure and a bolus of intravenous heparin administered following transseptal puncture.

The Inoue balloon (Toray Ltd, London), designed to help positioning at the mitral orifice to avoid left ventricular perforation and to allow dilatation over a range of sizes, is the standard equipment used in the UK. The balloon has differing elasticity along its length, causing the distal portion to dilate first followed by the proximal and middle segment (*Figures 3* and *4*).

Femoral arterial and venous sheaths are removed 3–4 hours following the procedure, and patients may go home the same or the following day. The GP may assist in follow-up by re-establishing anticoagulation, adjusting the dose of diuretic therapy and encouraging rehabilitation when a good result has been obtained. Late complications are few, but the patient should be re-referred if symptoms persist or recur.

SUCCESS RATE AND COMPLICATIONS

Successful PBMV provides an increase in valve area >1.5cm^2 without marked mitral regurgitation and produces symptomatic improvement, often by two or more New York Heart Association classes. These results are maintained at 5–10-year follow-up but, as with surgical valvotomy, restenosis may occur. Overall outcome and complication rates vary according to age, as illustrated by the results in a consecutive series of 300 patients who underwent PBMV in the authors' institution (*Table 2*). With the decline of acute rheumatic fever, UK patients are often elderly with comorbidity. The percutaneous procedure is well tolerated, even by the critically ill.

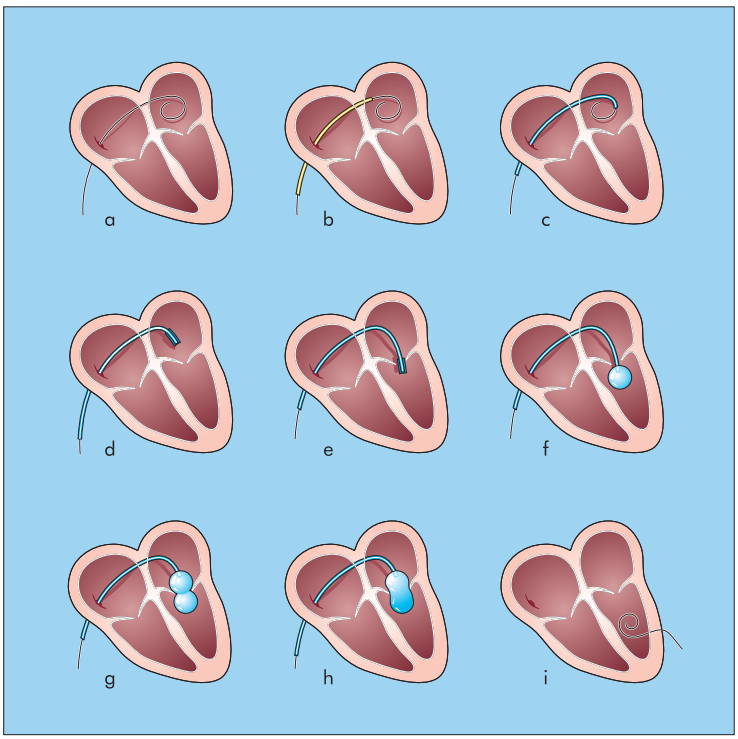
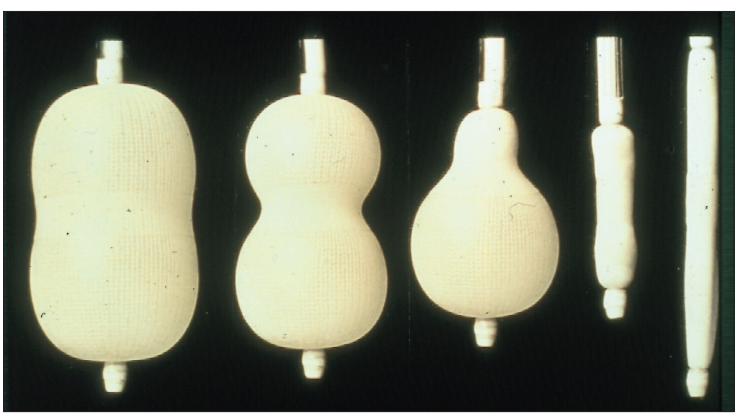


Figure 2. Schematic representation of percutaneous balloon mitral valvuloplasty. The Inoue technique uses a double loop guidewire, a 14F dilator (to increase the size of the atrial septal crossing site) and the Inoue balloon. A catheter, followed by the double loop guidewire, is advanced from the femoral vein via the right atrium and a trans-septal puncture into the left atrium (a and b). The Inoue balloon is passed over the guidewire (c) and manipulated across the mitral valve (d and e) before inflation for approximately 5 seconds (f, g and h). Serial inflations are undertaken using incremental balloon diameters until a satisfactory result is obtained. The severity of any mitral regurgitation is assessed by left ventriculography following each balloon inflation (i).

Figure 3. The Inoue balloon at various stages of inflation. Note the initial selective inflation of the distal balloon, which allows the balloon to be pulled back and positioned at the stenosed mitral orifice.



Haemopericardium may arise during transseptal catheterization. Embolism can be the result of an undetected left atrial thrombus or a valve fragment. Mild mitral regurgitation after dilatation is common. Severe regurgitation from a torn valve cusp can occur very occasionally (approximately 5%), particularly if the commissures are resistant, and may require MVR.

Significant shunting at the atrial septal puncture site is rare with the use of the Inoue balloon.

AVAILABILITY AND COST

PBMV is available in most cardiac centres. Usually, one cardiologist takes a special interest in the procedure to maintain an adequate caseload. The cost of the balloon and associated equipment is £1600, but the overall procedural cost is significantly less than valve replacement because of the shorter hospital stay.

TABLE 2.
Outcome and complications in a consecutive series of 300 UK patients, stratified according to age, who underwent percutaneous balloon mitral valvuloplasty in Edinburgh between 1986 and 1996

	Age (years)			
	<40	40–54	55–69	>70
Number of patients	17	81	122	80
Echo score (mean)*	4.1	5.5	7.2	8.0
Unsuitable for MVR	0%	6%	24%	69%
Valve area after PBMV (cm^2)	2.1	1.9	1.7	1.6
Increase in valve area (cm^2)	1.1	0.9	0.8	0.8
Increase in mitral regurgitation	18%	22%	15%	20%
Atrial septal defect > 1.2:1	0%	11%	11%	18%
Embolism	0%	0%	3%	4%
Cardiac tamponade	0%	0%	2%	0%
In-hospital mortality	0%	0%	3%	1%

* Score derived by semi-quantative assessment of mitral leaflet thickening, subvalvular change, leaflet mobility and valve calcification (each scored 0–4, overall range 0–16). TRD Shaw, unpublished data, 2000. MVR = mitral valve replacement; PBMV = percutaneous balloon mitral valvuloplasty

KEY POINTS

- Percutaneous balloon mitral valvuloplasty is the procedure of choice for patients with symptomatic mitral stenosis and pliable valves.
- The procedure also palliates symptoms in patients with defenerative mitral stenosis who are unable to undergo cardiac surgery.
- Preprocedural echocardiography (including transoesophageal imaging) is essential.
- The only contraindications are pre-existent moderate or severe mitral regurgitation and thrombus within the left atrial cavity.
- Immediate and long-term results are comparable with established surgical procedures.

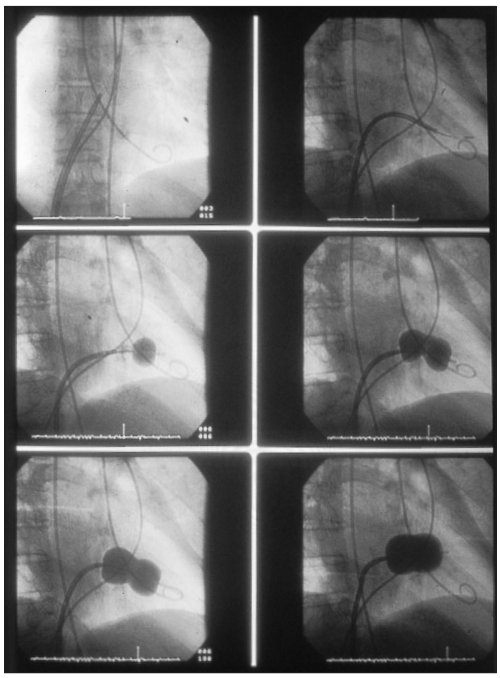


Figure 4. Percutaneous balloon mitral valvuloplasty using the Inoue balloon. The balloon straddles the stenosed mitral valve and the middle section can be progressively dilated to larger sizes.

CONCLUSIONS

PBMV is now the procedure of choice for patients with rheumatic mitral stenosis whose valves are suitable for a commissurotomy, or when surgery is contraindicated or at high risk. Best results are obtained when the valve shows commissural fusion, is pliable and non-calcified with no disease of the subvalvular apparatus. Immediate and long-term results of PBMV are comparable with established surgical procedures. HM

Conflict of interest: none.

Further reading

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