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Percutaneous mitral valvotomy by Inoue catheter in young patients with mitral stenosis

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Percutaneous balloon mitral valvotomy has rapidly evolved as a logical and viable alternative to surgical valvotomy. Most studies have demonstrated a significant increase in mitral valve area accompanied by substantial hemodynamic and clinical improvement. This has resulted in a variety of new techniques and balloon catheters to be used for mitral valvotomy in patients with severe rheumatic stenosis.[1-5] The double balloon technique has become quite popular in the West, while the Inoue balloon catheter continues to be exclusively used in Japan and in other parts of the Far East. We report in 60 patients the results of percutaneous mitral valvotomy of mitral stenosis with pliable leaflets using the Inoue balloon technique. We show that this is an effective and safe procedure with excellent hemodynamic and clinical results.

The study group consisted of 60 patients with symptomatic mitral stenosis who underwent percutaneous balloon valvotomy by the Inoue balloon catheter. Informed consent was obtained from all patients. There were 35 men and 25 women, who ranged in age from 15 to 35 years (mean 22 ± 8). Six patients were in New York Heart Association (NYHA) functional class II, 46 were in class III, and eight were in class IV. Two patients had undergone previous surgical valvotomy and two patients had had percutaneous balloon valvotomy. Six patients were in atrial fibrillation. Four patients had mild aortic regurgitation and three patients had mild mitral regurgitation (Sellers' grade +1[6]). The morphologic features of the mitral valve were assessed by cross-sectional echocardiography and care was taken to select only patients with good valve leaflet mobility, minimal thickening, and little or no subvalvular pathology and calcification. Patients with left atrial thrombus determined by transthoracic cross-sectional echocardiography were excluded.

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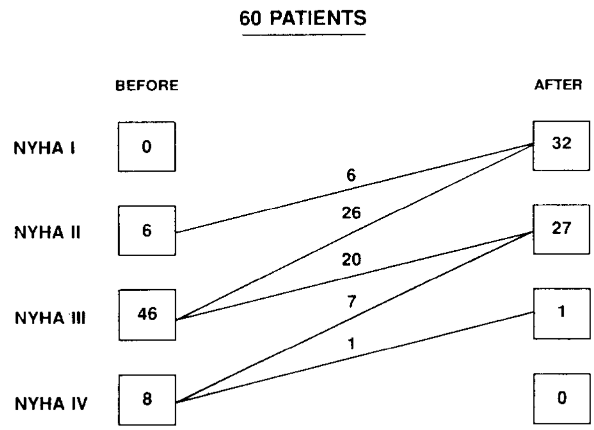

Fig. 1. Alterations in New York Heart Association functional classification following mitral valvotomy with Inoue catheter.

Table I. Hemodynamic results following percutaneous balloon valvotomy with the Inoue catheter

	Pre	*Post*	*p Value*
Transmitral gradient (mm Hg)	20 ± 6	4 ± 3	<0.001
Left atrial pressure (mm Hg)	32 ± 8	14 ± 6	<0.001
Mitral valve area (cm^2)	0.7 ± 0.2	2.1 ± 0.3	<0.001
Cardiac index ($L/min/m^2$)	2.5 ± 0.3	3.1 ± 0.2	<0.001

Cardiac catheterization. Right and left heart catheterization was performed via the right femoral vessels and the various pressures, cardiac output, and the transmitral gradient were recorded. Transseptal catheterization was performed with a 7F Mullins sheath, dilator, and Brockenbrough needle via the right femoral vein. No heparin was administered after instrument entry into the left atrium. No sedation was given before the procedure. An 0.28 inch stainless steel coiled guide wire was positioned in the left atrium. The Inoue catheter, elongated with the stiffening cannula, was threaded over the guide wire and positioned in the left atrium. The stiffening cannula and guide wire were removed. The Inoue catheter was negotiated across the mitral valve by means of a curved stylet with the balloon in a deflated state. We did not use carbon dioxide or air to inflate the balloon in any patient. Once the catheter was in the left ventricle, the distal end of the balloon was inflated by diluted contrast medium, the catheter was pulled back until the balloon straddled the ventricular surface of the stenosed mitral valve, and then the entire balloon was dilated until the waist disappeared. All hemodynamic variables including transmitral gradient, cardiac output, and an oximetric run were recorded following the procedure. Cardiac output was recorded by thermodilution in 20 patients and by the Fick method using assumed oxygen consumption in the remainder. Only size 26 and 28 mm diameter balloon catheters were used. All patients were observed overnight in the coronary care unit and most were discharged the next day. For statistical analysis, a paired t test was used to compare pre and post balloon valvotomy variables. Data are expressed as mean ± SD.

Results. Hemodynamic results following balloon valvotomy with the Inoue catheter are shown in Table I. Significant symptomatic and hemodynamic improvement was observed in all patients. Every patient improved symptomatically by at least one New York Heart Association functional class (Fig. 1). This was assessed 7 days following the procedure.

Complications. The Inoue catheter could be negotiated across the stenosed mitral valve in all 60 patients. Atrial septal defect assessed by oximetry was observed in four patients, but none had a left-to-right shunt (Qp/Qs) ratio greater than 1.5:1. Interestingly, these four patients required the greatest time for negotiating the Inoue catheter across the mitral valve. Mitral regurgitation (mild to moderate) developed in 10 patients, but no patient with a basal mitral regurgitation had an increase in severity. No patients developed systemic or pulmonary embolism. There was no incidence of cardiac tamponade or left ventricular rupture.

In developing nations with limited operative facilities in cardiovascular surgery, percutaneous balloon valvotomy should prove to be an effective alternative procedure. Mitral stenosis develops rapidly following acute rheumatic fever, resulting in small valve orifices with severe postcapillary pulmonary hypertension.[7, 8] The patients therefore, as in this study, tend to be much younger than those observed in the West. There is considerable fusion of the commissures with little or no calcification, and hence the valves are pliable and are quite amenable to balloon valvotomy. This is amply demonstrated in this study, where, based on data[9] and on our own preliminary experience, we selected patients with good valvular mobility and little subvalvular disease and calcification. Nobuyoshi et al.[10] used the Inoue balloon catheter in 106 patients with symptomatic improvement in 97 patients. They, however, achieved suboptimal hemodynamic and clinical results in semipliable and rigid leaflets. Moreover, the mean age of their population group was 53 ± 11 years.

The Inoue catheter was observed to be quite effective and also extremely safe. There was significant hemodynamic and clinical improvement in all patients with few or no complications. Atrial septal defect was found in only 4 of 60 patients with a Qp/Qs ratio of less than 1.5:1 in each case. This small incidence is a result of the fact that the Inoue catheter is elongated and is stiffened by a metal cannula. This results in an outer diameter of less than 12F, which is substantially smaller than an 8 mm balloon dilating the septum in the double balloon technique. Interestingly, these four patients had the longest time from transseptal catheterization to balloon dilatation. This may be because the septal puncture site acts as a fulcrum for the balloon catheter, and the greater time taken to negotiate the catheter across the mitral valve may have resulted in widening the perforation in the septum because of local friction. Another distinct advantage observed by us was the negligible contact and trauma to the left ventricle with the Inoue catheter. After the catheter is manipulated across the stenosed mitral valve, the distal half of the balloon is expanded and the catheter is pulled back against the mitral valve. This ensures that there is no contact with the ventricular endocardium and consequently no left ventricular rupture, which is a distinct possibility with the double balloon technique, as seen in a recent study.[5] Despite the fact that we did not administer heparin following transseptal catheterization to any of our patients, none developed systemic or pulmonary embolization. This is opposed to the procedure in most studies, but our experience has shown that routine heparin administration leads to an uncomfortable high percentage of bleeding from the femoral vessels after completion of the procedure. It is difficult to explain our negligible rate of embolization. It may be quite possible that our patients were young with little or no calcification, that the majority were in sinus rhythm, and that there may have been a lesser propensity for clot formation.

We have found the Inoue catheter effective, simple to operate, and quite safe in selected patients with mitral stenosis. The hemodynamic and clinical results produced by the Inoue catheter in this study are comparable to those obtained with the double balloon technique. It is imperative that comparative trials assessing the efficacy and safety of the Inoue and double balloon catheter techniques be conducted to make appropriate conclusions. However, a singular disadvantage with the Inoue catheter is the exorbitant cost, which proves to be the biggest deterrent against its widespread application in developing nations, where paradoxically it is needed the most.

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Transesophageal echocardiographic diagnosis of complex false aneurysm with aorto–left atrial communication complicating aortic valve and root replacement

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Despite considerable improvement in surgical techniques and antimicrobial therapy during the past several decades, cardiac valve replacement continues to be complicated by prosthetic valve endocarditis (PVE) in about 2% of cases.[1] Overall mortality rates for all forms of PVE remain greater than 50%. Among the recognized complications of PVE are perivalvular abscesses, false (mycotic) aneurysms that may lead to various degrees of aorto–left ventricular discontinuity, aortoatrial and aortoventricular fistulas, and leaflet destruction.[2, 3] Perivalvular abscesses are frequent in cases of endocarditis involving rigid frame prosthetic valves.[4] Early detection and comprehensive structural and functional delineation of these complications are critical so that timely surgical treatment can be instituted.[5] Prior to the introduction of transesophageal echocardiography (TEE), transthoracic echocardiography was widely accepted as the most useful noninvasive method of diagnosing PVE and its associated complications. Frequently in patients with recent valve replacement, however, only a limited interrogation of valves is possible by the transthoracic approach. Cardiac catheterization is not without risks and may not provide the definitive information necessary to mandate early surgical intervention.[6, 7] TEE would thus appear to have significant advantages as a safe,[8] rapid, and precise means of identifying complications of valve replacement that may not be well seen by other imaging modalities.[9-12] The following case report demonstrates the value of TEE in the precise delineation of the rupture of a false aneurysm at the aortic root leading to a complex aorto–left atrial

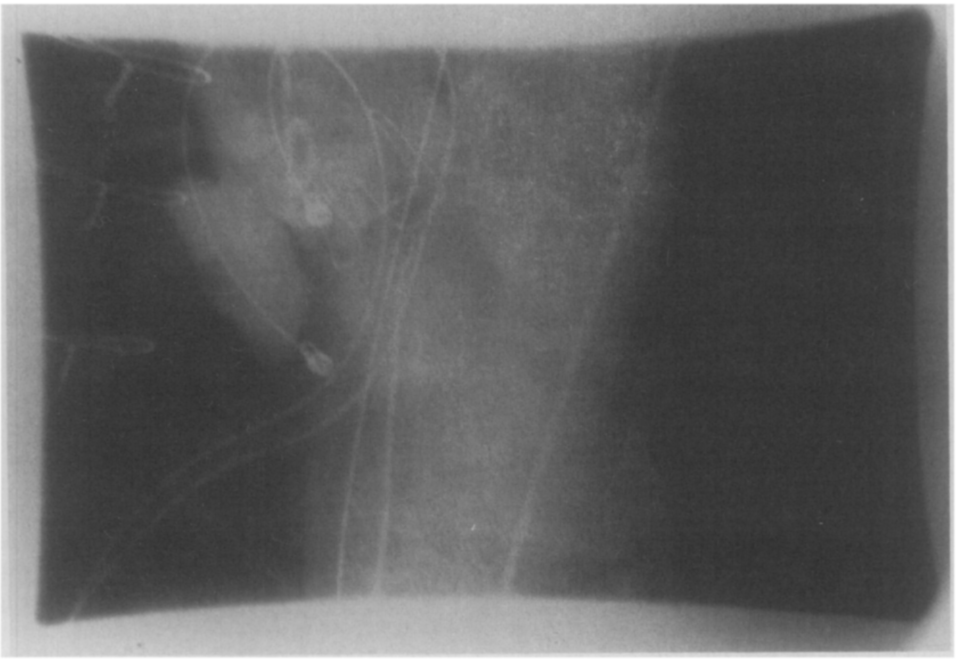

Fig. 1. Left anterior oblique projection of an aortogram showing opacification of the aortic root and extravasation of contrast into a periaortic cavity. Struts of the porcine prosthetic aortic valve are noted. There was no evidence of valve dehiscence.