in the kidney inhibits the release of kallikrein into urine.[12] Decreased urinary kallikrein excretion found in our patients with CHF could be a consequence of increased sympathetic stimulation.

We evaluated the renal kallikrein-kinin system by urinary kallikrein measurements. Our data suggest that this intrarrenal hormonal system involved in water and electrolyte excretion and renal blood flow regulation may be part of an abnormal neurohumoral axis in CHF.

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Comparison of Mitral Valve Area Results of Balloon Mitral Valvotomy Using the Inoue and Double Balloon Techniques

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Inoue pioneered the mitral balloon valvotomy technique using his homemade balloon catheter as a nonsurgical therapeutic alternative to the surgical treatment of mitral stenosis.[1] Because Inoue's balloon catheter was not commercially available at the time, Zaibag et al[2] developed the principal of the double balloon technique.[2] The double balloon technique has prevailed to date since the mitral valve areas achieved are excellent and are maintained at long-term follow-up.[2-4] Although the mechanism of mitral valve dilatation for both the Inoue and the double balloon technique are similar,[1-5] i.e., commissural splitting, no comparative clinical data have been reported. Previous published series include noncomparable groups of patients, with different ages and particularly different mitral valve and subvalvular anatomy.[1-4] We selected a homogenous, young population of patients with severe rheumatic mitral stenosis; both groups of patients had comparable mitral valve and subvalvular anatomy and age. The objective of the study was to compare the mitral valve areas and the total procedure times achieved, using the 2 different techniques.

We selected 16 patients according to the following criteria: (1) severe symptomatic pliable mitral valve stenosis with a mitral valve area <1.1 cm², (2) mitral valve regurgitation <grade 1 (Sellers classification), (3) echocardiographic score ≤8 using the Block classification,[6] and (4) absence of calcification of the mitral commissures. Nine patients were randomly assigned to group 1 for balloon valvotomy using 2 Mansfield balloon catheters (20 + 20 mm in diameter) and 9 patients to group 2 using the Inoue balloon technique with 26- to 30-mm balloon catheters.[1] Group I consisted of 5 men and 3 women (mean age ± standard deviation 31 ± 11 years). Six patients were in New York Heart Association class II and 2 in class III. The mean age of the 8 patients (4 men and 4 women) in group 2 was 32 ± 11 years; 7 patients were in New York Heart Association class II and 1 in class III. All 16 patients were in sinus rhythm.

The double balloon mitral valvotomy technique, using 20 + 20-mm Mansfield balloon catheters, has been previously described and was performed in group 1 patients (Figure 1).[2,3] In group 2 patients, mitral balloon valvotomy was performed using the Inoue balloon technique[1] and the balloon size selection was made according to the Inoue criteria (Figure 2).[1] Stepwise echo/Doppler mitral balloon dilatation was done according to the Inoue technique. The total procedure time was taken as skin to skin. The mitral valve area was calculated using the Gorlin formula with direct left atrial/left ventricular transmitral pressure gradient. The Gorlin mitral valve area was measured before and after balloon valvotomy. Cardi-

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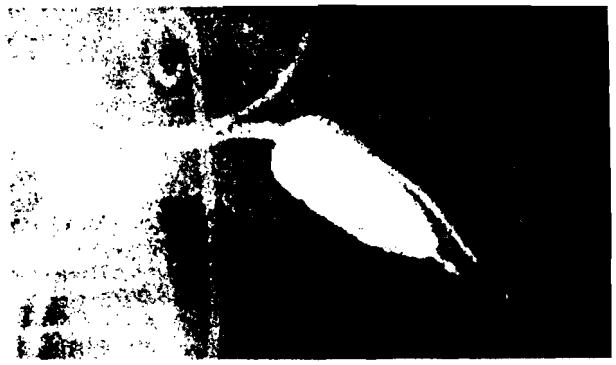

FIGURE 1. Double balloon valvotomy technique using the 2 Mansfield balloon catheters in a patient from group 1.

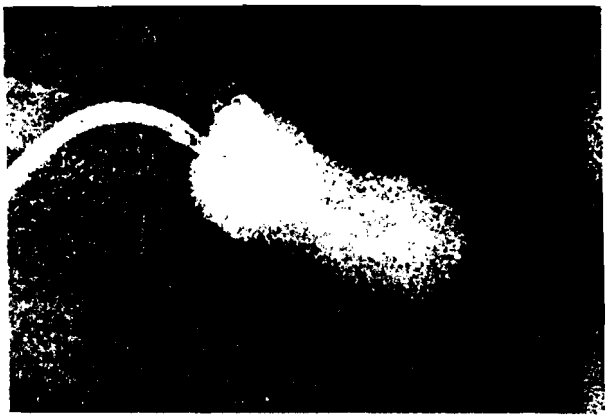

FIGURE 2. Inoue balloon valvotomy in a patient from group 2.

ac output was measured using the thermodilution technique. Left ventricular angiography was performed both before and after balloon valvotomy. The angiographic degree of mitral regurgitation was assessed using the Sellers classification.

Mean ± standard deviation was calculated in the usual way. A Student's t *test was used to test the significance between the means.*

Group 1: *The mean mitral valve area increased from 0.8 ± 0.2 to 1.9 ± 0.5 cm² ($p < 0.001$). One patient developed grade I mitral regurgitation. Residual stenosis persisted in 1 patient with a mitral valve area <1.5 cm². The mean total procedure time was 220 ± 30 minutes.*

Group 2: *The mean mitral valve area increased from 0.8 ± 0.2 to 1.8 ± 0.5 cm² ($p < 0.01$). The degree of mitral regurgitation increased from grade I to II in 1 patient. Residual stenosis persisted in 2 patients with mitral valve area ≤1.5 cm². The mean total procedure time was 140 ± 41 minutes.*

Mitral balloon valvotomy is an established therapeutic alternative to the surgical treatment of mitral stenosis.[1-4] The mechanism of both single and double mitral balloon valvotomy is similar to surgical valvotomy, i.e., commissural splitting.[1-5] This study has clearly shown that the mitral valve area achieved after balloon valvotomy is similar using both the Inoue and the double balloon Mansfield technique. Both groups of patients had comparable mitral valve and subvalvular anatomy as evaluated by echocardiography. Previous published series of the Inoue balloon and the double balloon mitral valvotomy techniques included a heterogenous population of patients[1-4] with noncomparable mitral valve and subvalvular apparatus. Studies, both in vitro and in vivo, demonstrated that the mitral and subvalvular apparatus status were the major determining factors in achieving good mitral valve areas after balloon valvotomy.[1-3,4,6]

Our study included 2 small groups of patients with similar valvular and subvalvular anatomy. Larger studies comparing these 2 techniques are required to evaluate the incidence of iatrogenic mitral regurgitation between the 2 different techniques. The incidence of iatrogenic atrial septal defects is small using either technique.[1-3]

The double balloon technique using the long transeptal sheath is difficult to master. The Inoue balloon technique is less demanding than the double balloon technique and consequently decreases the total procedure time significantly. This advantage may be outweighed by the expense of the balloon catheter: 4 times that of 2 standard Mansfield balloon catheters. This factor is particularly relevant in third world countries where mitral valve stenosis is prevalent.

We conclude that both the Inoue balloon catheter and the double balloon technique achieve similar mitral valve areas. The Inoue balloon is technically less demanding and decreases total procedure time, compared with the double balloon Mansfield technique. This advantage should be weighed against the expense of the device.

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