

# Percutaneous balloon valvuloplasty for bioprosthetic mitral valve stenosis: A case report and review of the literature.

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## **Abstract**

**197 words**

Percutaneous transcatheter mitral valvuloplasty is the indicated treatment of choice for symptomatic native mitral valve stenosis, but there have been limited reports of successful procedures of balloon valvuloplasty for bioprosthetic mitral valve stenosis. We present a case of 62-year-old woman suffering from progressive dyspnea due to bioprosthetic mitral valve stenosis. The measured mean pressure gradient across the mitral valve was 30 mmHg, and mitral valve area was 0.73 cm<sup>2</sup>. Redoing mitral replacement was considered high risk and refused by the patient. Percutaneous balloon valvuloplasty was performed with an Inoue balloon catheter inflated to 20 mm. The patient's symptoms immediately improved after the procedure without any procedure related complications. The mean pressure gradient across the valve decreased to 19 mmHg, and the mitral valve area became 1.21cm<sup>2</sup> in post procedural echocardiography. We conducted a literature search and identified 26 cases of balloon valvuloplasty for degenerated bioprosthetic valves. Of these, 14 cases were bioprosthetic mitral valves and the results were favorable. However, more case reports are required to establish a base for future expert recommendation of balloon valvuloplasty of prosthetic mitral valve. Balloon valvuloplasty will serve a very niche

role in highly selected patients with prosthetic mitral valve stenosis.

**Keywords:** balloon valvuloplasty, prosthetic mitral valve stenosis

## **Main Documents**

**1883 words**

## **Introduction**

Percutaneous transcatheter balloon valvuloplasty is a technique which was introduced in 1982 by Kanji Inoue[1] and eventually became the procedure of choice for most cases of native mitral valve stenosis[2]. However, balloon valvuloplasty for degenerated bioprosthetic mitral valve is rarely performed. We report a successful case of balloon valvuloplasty in a patient with a prosthetic mitral valve stenosis and review the related literatures.

## **Case Report**

A 62-year-old woman with progressive dyspnea in a New York Heart Association functional class III was referred to our hospital for a treatment of bioprosthetic mitral valve stenosis. Transthoracic and transesophageal echocardiography revealed severe bioprosthetic mitral stenosis with elevated pulmonary artery systolic pressure of 85 mmHg. The measured mean

pressure gradient across the mitral valve was 30 mmHg, and mitral valve area calculated by pressure half-time was 0.73 cm<sup>2</sup> (Figure 1A). There was no thrombus and trivial mitral regurgitation on the echocardiography.

The patient had a history of coronary artery bypass graft surgery with a left internal mammary artery graft to the left anterior descending artery and 2 saphenous vein grafts to the distal right coronary and second marginal coronary arterial segments 9 years ago. Subsequently, the patient had undergone mitral valve replacement with a 23 mm Carpentier-Edwards bioprosthesis for mitral regurgitation, and aortic valve replacement with a 19 mm Carpentier-Edwards bioprosthesis for aortic stenosis 4 years ago. The patient suffered a gangrenous right foot and required amputation 1 month ago, and the wound healing was delayed. Just after the amputation, the patient developed congestive heart failure due to severe bioprosthetic mitral valve stenosis that was resistant to medical treatments. Redo mitral valve replacement was required, but the Society of Thoracic Surgeons (STS) score predicted a 32.0% risk of death for redo surgery. The patient rejected open surgery and consented to percutaneous balloon valvuloplasty.

Right heart catheterization showed that the pulmonary capillary wedge pressure was 39 mmHg, and the mean pulmonary artery pressure was 55 mmHg. Balloon valvuloplasty was performed as previously described with sequential inflations from 17mm to 20mm with a

20-mm Inoue balloon (Figure 2). After the balloon valvuloplasty, the pulmonary capillary wedge pressure decreased to 29 mmHg, and the mean pulmonary artery pressure decreased to 41 mmHg. Cardiac index increased from 1.5 l/min/m<sup>2</sup> to 2.0 l/min/m<sup>2</sup>. The hemodynamic findings immediately before and after valvuloplasty are shown in Table 1. Transthoracic echocardiography which was performed two days later showed that the mean pressure gradient across the mitral valve reduced to 19 mmHg, and mitral valve area increased to 1.21 cm<sup>2</sup> with trivial mitral regurgitation (Figure 1B). The patient's symptoms improved and exercise capacity increased immediately. There was no complication associated with the procedure. The patient was discharged from the hospital 5 days after the procedure.

## **Discussion**

Percutaneous transcatheter balloon valvuloplasty was first performed in 1982 by Kanji Inoue who is the main operator of the present case and also the author of the present report[1]. After proving its clinical efficacy in several data, percutaneous mitral valvuloplasty has now become the indicated treatment in criterion-suitable cases of native mitral valve stenosis[2]. Balloon valvuloplasty for other valves including aortic, tricuspid, pulmonary valve have also been performed in well selected patients with favorable outcomes[3]. In

particular, balloon aortic valvuloplasty is currently being applied more frequently compared to the past with the advent of transcatheter aortic valve replacement[4, 5]. However, the reports regarding balloon valvuloplasty for bioprosthetic valve failure in adult patients are extremely limited. A literature search identified 26 cases of balloon valvuloplasty for degenerated bioprosthetic valve; 14 cases in mitral position[6–16], 6 cases in aortic position[17, 18, 16, 19, 20], 4 cases in tricuspid position[21–24], and 2 case in pulmonary position(Table 2)[25][16]. The valvuloplasty for degenerative bioprosthesis in aortic position showed poorer outcomes; 2 patients died after the procedure and 2 patient required surgical valve replacement[17, 19, 16]. Valvuloplasty for bioprosthetic valve stenosis in other positions showed more favorable outcome. After balloon valvuloplasty, symptoms of almost all patients improved. One patient after balloon valvuloplasty for prosthetic mitral valve developed a moderate mitral regurgitation at 6 month follow-up and a cusp rupture at 12 month[16]. Although no major procedure related complications were reported except for this patient, several authors have warned against performing valvuloplasty of bioprosthetic mitral valve[26]. The dysfunction or obstruction of prosthetic valve usually results from pannus ingrowth, leaflet calcification, thrombosis or vegetation. In vitro studies suggest that the increased mitral valve area attained from balloon valvuloplasty results from balloon induced leaflet tearing, calcium fractures, and cusp perforation[27]. We cannot draw any concrete

conclusions from these limited experiences, more case reports are needed to establish a base for future expert recommendation of balloon valvuloplasty of prosthetic mitral valve.

Recently, the transcatheter valve-in-valve technique is emerging as a therapeutic option for patients with failure of previously implanted bioprosthetic valve[28, 29]. After receiving the favorable results for bioprosthetic aortic valve, the valve-in-valve technique for bioprosthetic mitral valve has been applied using the transapical approach and expected to become a complementary approach to redo mitral valve replacement. Although the valve-in-valve technique seems hopeful, the Ministry of Health, Labor and Welfare has not approved the valve-in-valve procedure for mitral valve in Japan. When compared to the valve-in-valve technique, the main advantage of balloon valvuloplasty is the less invasive percutaneous approach, omitting the need for apical incision and general anesthesia.

In conclusion, the present report demonstrates the successful use of percutaneous transcatheter balloon valvuloplasty for bioprosthetic mitral valve stenosis. Balloon valvuloplasty for prosthetic mitral valve shows favorable outcomes in limited case reports. However, there are other opinions that warned against performing valvuloplasty for prosthetic mitral valve since the balloon valvuloplasty inevitable induce leaflet tearing, calcium fractures, and cusp perforation. More evidences are required to establish a concrete recommendation for balloon valvuloplasty for bioprosthetic mitral valve. Balloon

valvuloplasty will serve a very niche role in highly selected patients with prosthetic mitral valve stenosis who is at high risk for redo mitral valve replacement and valve-in-valve procedure.

## **Disclosures**

Kanji Inoue holds all patents of the Inoue balloon. The Inoue balloon was developed and made by Kanji Inoue. All the other authors report no financial relationships or conflicts of interest regarding the content herein.

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## Figures Captions

Figure 1. A, Parasternal long axis view showing degenerated bioprosthesis mitral valve with trivial mitral regurgitation. B, Before the balloon valvuloplasty, mitral valve area was 0.73 cm<sup>2</sup>, and mean pressure gradient was 30 mmHg. C, After the balloon valvuloplasty, parasternal long axis view shows no worsening of mitral regurgitation. D,

The mitral valve area increased to 1.21 cm<sup>2</sup>, and mean pressure gradient decreased to 19 mmHg.

Figure 2. A, Fluoroscopic image demonstrating the Inoue balloon passing through the stenotic bioprosthetic valve. B, Balloon valvuloplasty was performed with the Inoue balloon with a maximum diameter of 20mm.

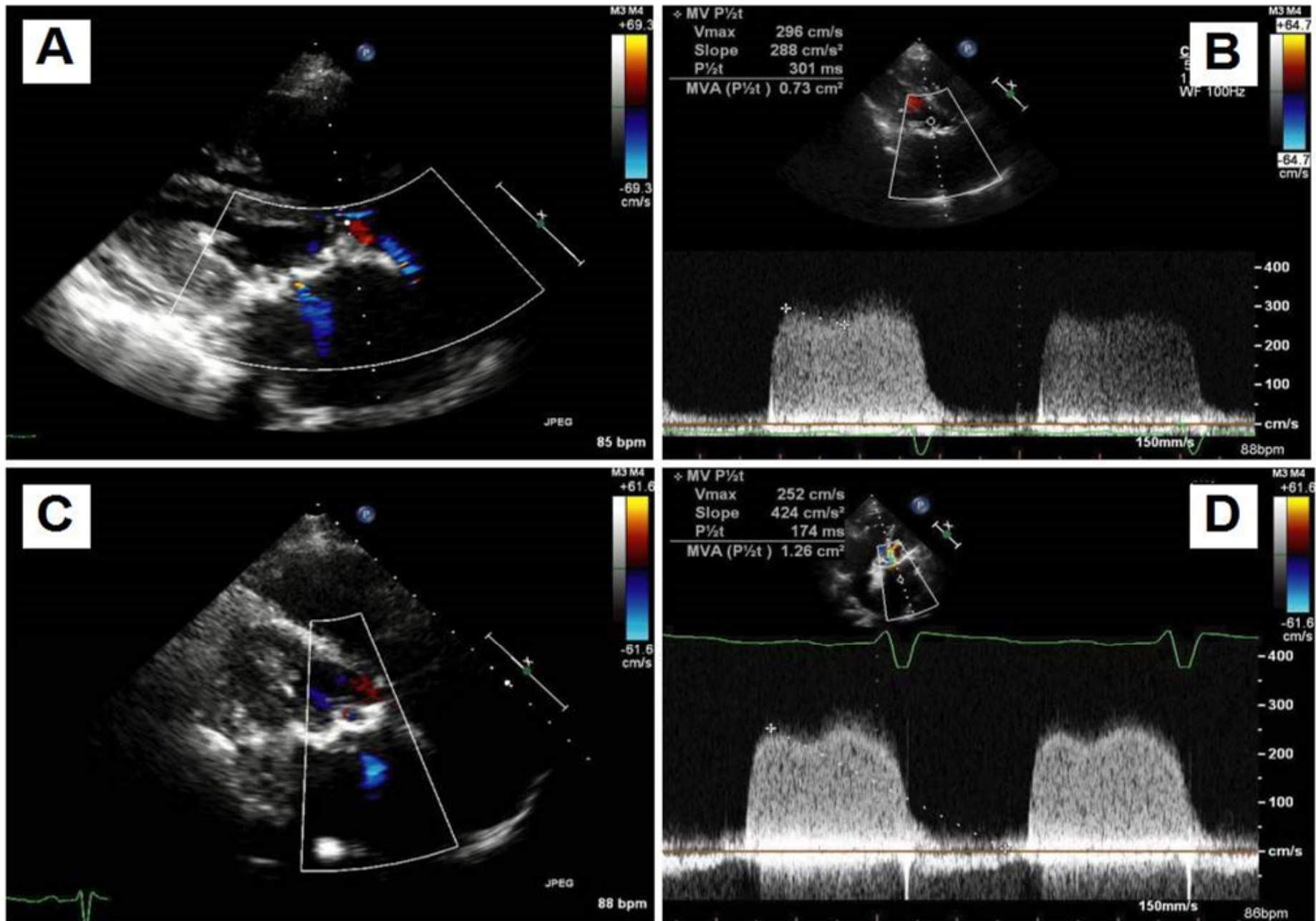


Figure 1.

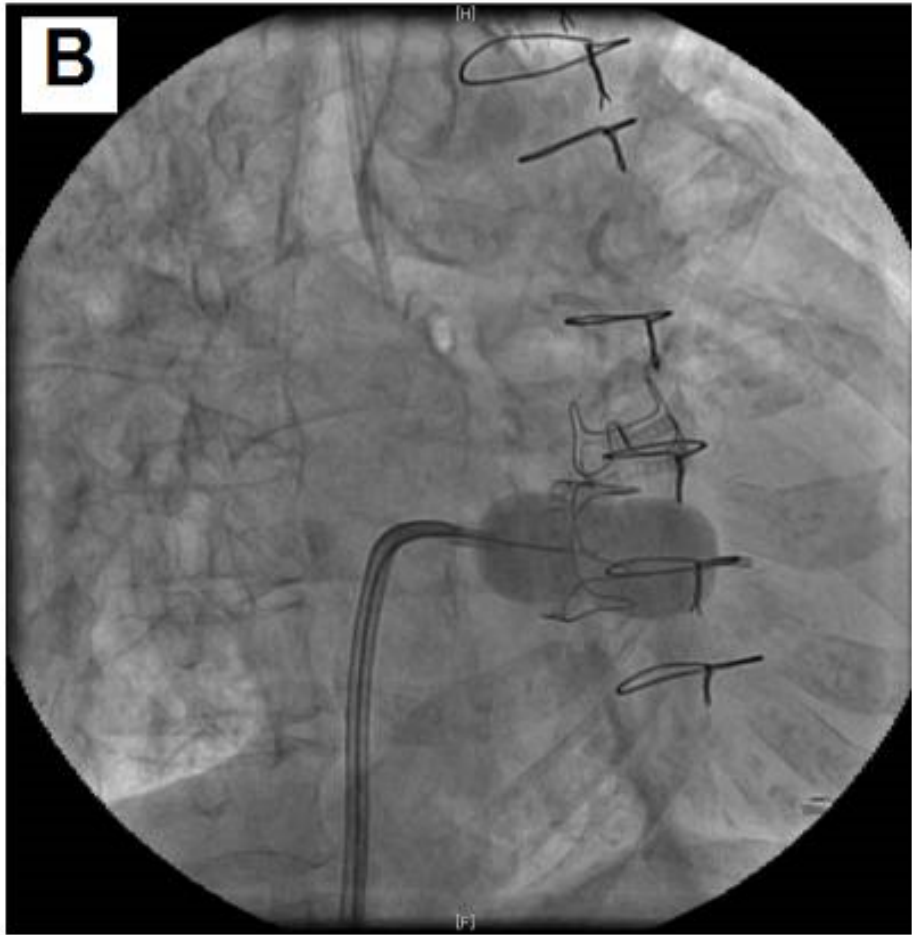
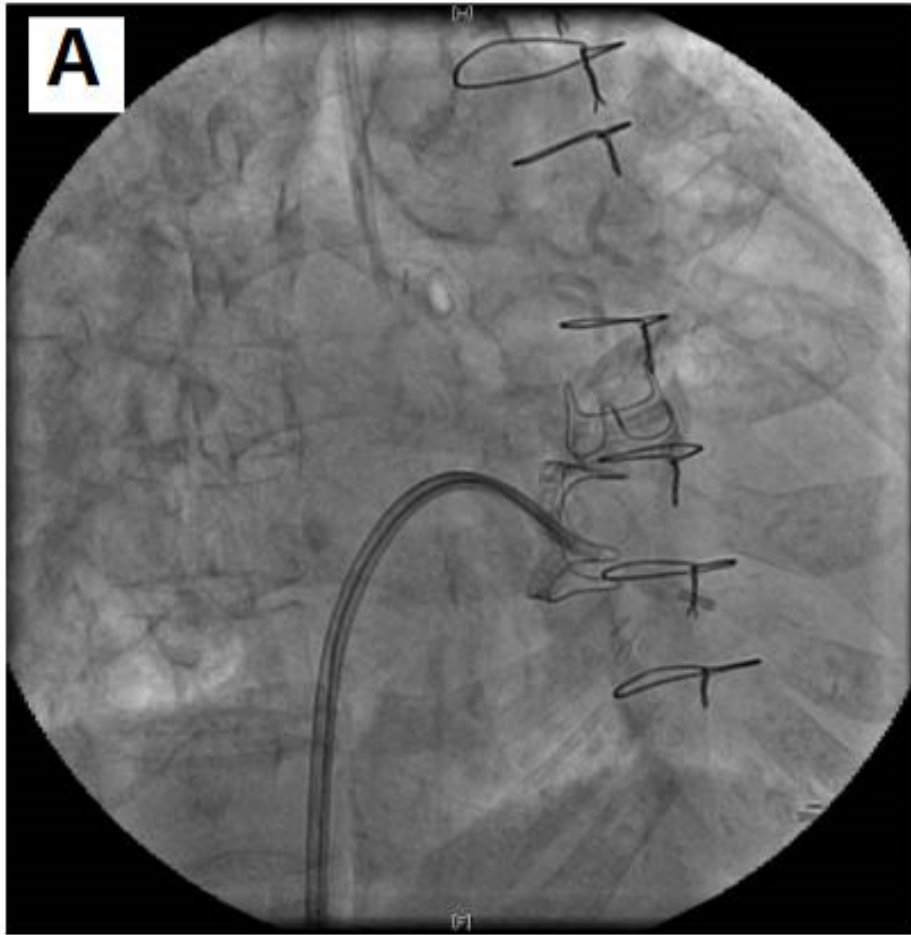


Figure 2.

**Tabel 2. Reports of balloon valvuloplasty in bioprosthesis**

Author (year)	Age/Sex	Valve Position	valve age	PG pre procedure (mmHg)	PG post procedure (mmHg)	Balloon type/size (mm)	Complications
Calvo et al (1987) [6]	29 M	Mitral	10	15	11	Trefoil 25mm	Mild MR
Calvo et al (1987) [6]	37 F	Mitral	3	13	3	Trefoil 25mm	None
Arie et al (1989) [7]	62 F	Mitral	13	13	8	Mansfield 20mm	None
Cox et al (1989) [8]	53 F	Mitral	13	11	6	Cook 23mm	Mild MR, Restenosis
Fernandez et al (1990) [9]	62 F	Mitral	10	22	6	Mansfield 20mm	None
Spellburg et al (1991) [10]	64 F	Mitral	8	30	10	Mansfield 18mm	Atrial shunt
Babic et al (1991) [11]	34 M	Mitral	3	29	9	Mansfield 25mm	None
Orbe et al (1991) [16]	N/A	Mitral	10	15	11	Trefoil 25mm	Severe MR
Orbe et al (1991) [16]	N/A	Mitral	3	13	3	Trefoil 25mm	None
Orbe et al (1991) [16]	N/A	Mitral	7	16	5	Monoballoon 25mm	None
Lip et al (1997) [12]	29 F	Mitral	6	12	2~4	Inoue 28mm	None
Ludman et al (1999) [13]	54 F	Mitral	9	N/A	N/A	Inoue N/A	None
Hurst et al (2004) [14]	78 M	Mitral	1.5	14	11	Inoue 26mm	None
Bekeredjian et al (2010) [15]	86 F	Mitral	9	9	5	Inoue 26mm	None
Mckay et al (1988) [17]	28 M	Aortic	6	57	41	Mansfield 20mm	Surgical Replacement
Mckay et al (1988) [17]	31 F	Aortic	10	81	38	Mansfield 15mm	Death
Ramondo et al (1989) [18]	60 M	Aortic	6	110	25	Schneider 18mm	None
Orbe et al (1991) [16]	N/A	Aortic	8	60	40	N/A	Surgical Replacement
Kirwan et al (2004) [19]	79 M	Aortic	18	80	45	N/A 15mm	Death due to Acute AR
Dejam et al (2011) [20]	90 F	Aortic	15	55	36	Diamond 14mm	Restenosis in 8 months
Feit et al (1986) [21]	46 M	Tricuspid	10	22	15	Meditech 20	None
Wren et al (1989) [22]	19 F	Tricuspid	13	8~10	4~6	Mansfield 20mm	Restenosis in 3 months
Chow et al (1990) [23]	67 F	Tricuspid	7	6	2.5	Cook 23mm	None
Yunoki et al (2006) [24]	59 F	Tricuspid	22	14	6	N/A 25mm	None
Orbe et al (1991) [16]	N/A	Pulmonary	12	70	50	N/A	None
Oomman et al (2004) [25]	20 M	Pulmonary	9	100	50	Inoue 20mm	None

PG, pressure gradient, MR, mitral regurgitation, AR, aortic regurgitation, N/A, not available

Table 1. Hemodynamic data before and after the balloon valvuloplasty

<b>Hemodynamic Findings</b>	<b>Before</b>	<b>After</b>
Heart Rate	80	75
Pressure (mmHg)		
Mean Pulmonary Capillary Wedge	39	29
Pulmonary Artery (mean)	88/39 (55)	70/27 (41)
Right Ventricle	82/11	51/9
Mean Right Atrium	17	15
Cardiac Index (l/m/m2)	1.5	2.0