

## Two-Year Experience of the Batista Operation for Non-Ischemic Cardiomyopathy

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### Abstract

The Batista operation was performed in 30 patients (25 men and 5 women, mean age 47 years) to treat cardiac failure due to non-ischemic cardiomyopathy, mostly idiopathic dilated cardiomyopathy, from December 1996 to June 1998. Preoperative New York Heart Association (NYHA) class was IV in 21 patients including 17 receiving inotropic support, and class III in 9 patients. Seven patients required emergency surgery because of on-going shock and 23 patients were operated electively. Combined cardiac procedures were; mitral valve reconstruction in 26 patients (19 replacements, 7 repairs), tricuspid annuloplasty in 15, aortic valve replacement in 3 and one each of maze and coronary artery bypass grafting.

All patients successfully weaned from cardiopulmonary bypass. Intraaortic balloon pump was used in 6 patients but no left ventricular assist device was used. Two of 23 patients (8.7%) who underwent elective operation died during hospitalization and 3 patients (13.0%) died in the late period. Six of 7 patients (85.7%) with emergency operation died in the hospital and only one survived. Sixteen of 19 survivors returned to NYHA class I–II, and 3 were in class III. Mean ejection fraction increased from  $18 \pm 6\%$  to  $31 \pm 5\%$ . Diastolic dimension decreased from  $79 \pm 8$  to  $60 \pm 8$  mm. End-diastolic and systolic volume indices decreased from  $203 \pm 43$  to  $103 \pm 25$  ml/m<sup>2</sup> and from  $164 \pm 39$  to  $70 \pm 25$  ml/m<sup>2</sup>, respectively, at the second postoperative week. Six patients had ventriculography at one year after the operation, and no redilatation was noted. Increased thickness of left ventricular wall was observed postoperatively.

The Batista operation can be performed with relatively low risk and clinical improvement was obvious in elective operation, whereas risk is very high in emergency cases. Therefore, proper guidelines for patient selection and choice of procedure are critically important to achieve a successful outcome in the Batista operation.

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### Key Words

- Cardiac surgery
- Cardiomyopathies (dilated)
- Heart failure
- Ventricular function
- Ventricular remodeling

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## INTRODUCTION

In countries where cardiac transplantation is not adequately available, non-transplant cardiac surgical procedures for patients with end-stage heart failure are highly desirable. The Batista operation<sup>1)</sup> was performed in 30 patients with non-ischemic dilated cardiomyopathy (DCM) in Japan since December 1996 and our 2-year experience is reported here, a part of which was published previously<sup>2,3)</sup>.

## MATERIALS AND METHODS

From December 1996 to June 1998, the Batista operation was performed in 30 patients at Shonan Kamakura General Hospital ( $n = 27$ ) and affiliated hospitals ( $n = 3$ ).

Because this operation is still experimental, we carefully set up the candidate screening process. First, consensus was obtained on the correct diagnosis of non-ischemic dilated cardiomyopathy (Fig. 1), with the diameter of the left ventricle larger than 7 cm with New York Heart Association (NYHA) class III–IV, judged by at least 2 independent cardiologists. Then cardiac surgeons assessed the operability. We then discussed the procedure with patient and family and obtained their informed consent. Finally, the hospital ethics committee and institutional review board gave approval for each case.

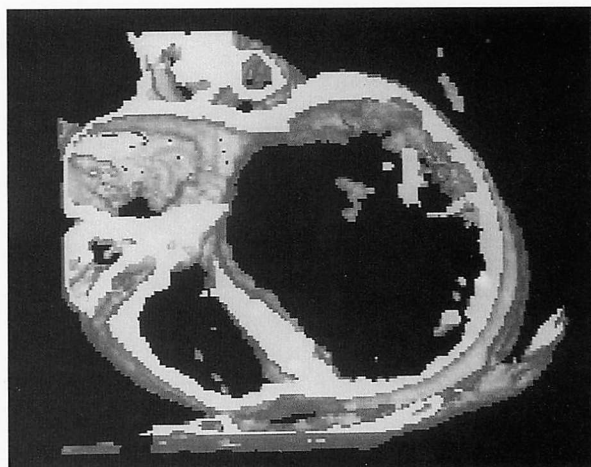
There were 25 men and 5 women aged from 14 to 67 years (mean 47 years). Etiology of DCM was idiopathic in 22 patients, valvular in 3, dilated phase of hypertrophic cardiomyopathy in 2 and one each of arrhythmogenic right ventricular dysplasia associated with dilated left ventricle, sarcoidosis and corrected transposition of the great arteries (Table 1). There were 3 patients who had previous cardiac operation (mitral valve replacement in 2 patients and Bentall operation in one).

Preoperative NYHA class was IV in 21 patients including 17 receiving inotropic drip infusion support and class III in 9. Significant mitral, tricuspid and aortic regurgitations were noted in 27, 18 and 3 patients, respectively (Table 2). Seven of them were treated urgently under on-going shock due to progressive pulmonary edema or cardiac arrest and the other 23 had elective operation.

Mean preoperative left ventricular ejection fraction was  $18 \pm 6\%$  (6–28%). Mean left ventricular diastolic dimension was  $79 \pm 8$  mm (71–88 mm)

## Selected abbreviations and acronyms

DCM = dilated cardiomyopathy  
PLV = partial left ventriculectomy



**Fig. 1** Typical findings of the left ventricle in a patient with idiopathic dilated cardiomyopathy. The spherically dilated left ventricle with a thin wall is shown by ultra-fast emission beam tomography (Imatron).

**Table 1** Characteristics of patients

Number of patients	30
Age (yr)	47 (14–67)
Female	5
Etiologies of dilated cardiomyopathy	
Idiopathic	22
Valvular	3
Dilated phase of hypertrophic cardiomyopathy	2
Arrhythmogenic right ventricular dysplasia	1
Sarcoidosis	1
Corrected transposition of great arteries	1

**Table 2** Cardiac status of patients

Valvular insufficiency	
Mitral	27
Tricuspid	18
Aortic	3
NYHA class IV (inotropes)	21 (17)
III	9

Inotropes: supported by catecholamine infusion.  
NYHA = New York Heart Association.

and mean end-diastolic and systolic volume indices were  $203 \pm 43$  and  $164 \pm 39$  ml/m<sup>2</sup>, respectively.

### SURGICAL TECHNIQUES

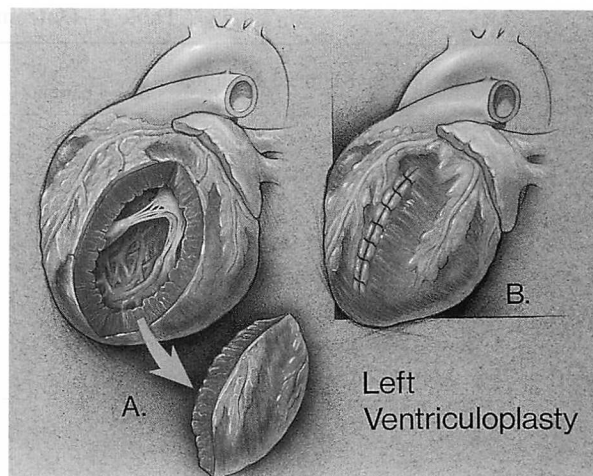
Through a median sternotomy, normothermic cardiopulmonary bypass and antegrade warm blood cardioplegia was used for partial left ventriculectomy (PLV) for the initial 15 patients except for the first case who was operated under the on-pump beating heart. Then we switched back to the on-pump beating heart without cardioplegic arrest for PLV in the latter 15 patients. The posterolateral ventricular free wall between anterior and posterior papillary muscles was excised as Batista<sup>1)</sup> described to accomplish left ventricular downsizing (**Fig. 2**). In patients with the mitral regurgitation, mitral valve was replaced with tissue prosthesis through left ventriculotomy or reconstructed by annuloplasty using the flexible ring through left atriotomy. Tricuspid annuloplasty with DeVega's procedure was concomitantly performed if necessary.

Left ventriculotomy was closed with double layer sutures with large needle 2–0 polypropylene stiches (Matsuda Ika Kogyo, Japan), and bovine pericardial strips was used for reinforcement occasionally.

Combined cardiac procedures are shown in **Table 3**. Mean aortic cross-clamp time was  $79 \pm 32$  min in the cardioplegia group. Cardiopulmonary bypass time was  $152 \pm 51$  min in the cardioplegia group and  $119 \pm 54$  min in the beating heart group, respectively.

### RESULTS

All patients were successfully weaned from the cardiopulmonary bypass. Intraaortic balloon pump was used in 6 patients, but left ventricular assist device was not necessary. In elective operations of 23 patients including 10 who became inotropic medication dependent, 2 (8.7%) died during hospitalization due to pneumonia (12th postoperative day) and heart failure (133rd postoperative day), respectively, and the other 3 (13.0%) died later due to stroke caused by prosthetic valve emboli at 3 months, recurrent heart failure at 7 months and hepatic failure at 2 months, respectively. On the other hand, in 7 patients who were urgently operated, 6 patients (85.7%) died during hospitalization due to several reasons such as infection, arrhythmia, mitral valve reoperation and/or multiorgan failure. Only one who survived was doing well



**Fig. 2** Schema of the Batista operation

**Table 3** Procedures used in Batista operation

Partial left ventriculectomy alone	3
With MVP	4
+ TAP	1
+ AVR	1
With MVR	6
+ TAP (maze operation)	13(1)
With MVR + AVR + TAP (CABG)	2(1)
Intraaortic balloon pump	6
Left ventricular assist device	0

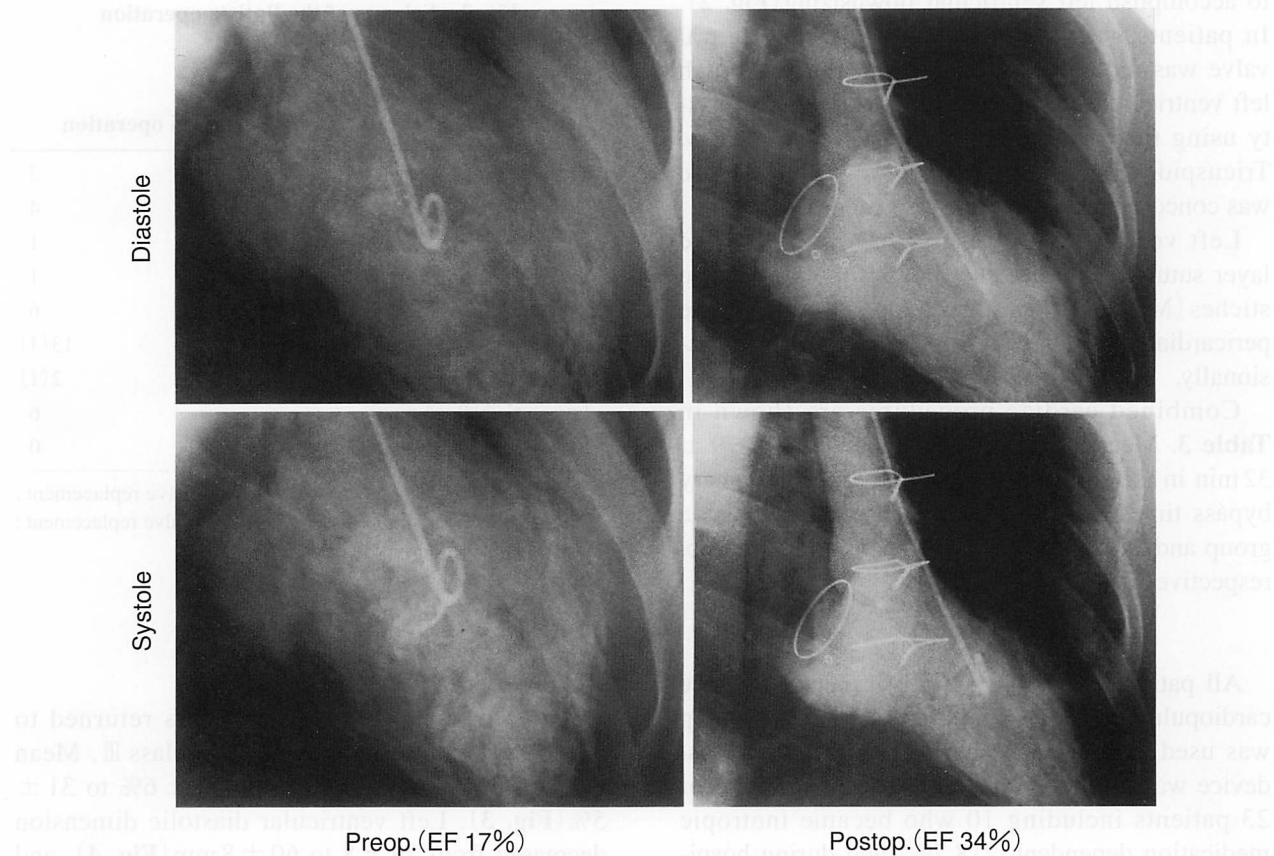
MVP=mitral valve plasty; MVR=mitral valve replacement; TAP=tricuspid valve plasty; AVR=aortic valve replacement; CABG=coronary artery bypass grafting.

without heart failure (**Table 4**).

Among 19 survivors, 16 patients returned to NYHA class I–II, and 3 were in class III. Mean ejection fraction increased from  $18 \pm 6\%$  to  $31 \pm 5\%$  (**Fig. 3**). Left ventricular diastolic dimension decreased from  $79 \pm 8$  to  $60 \pm 8$  mm (**Fig. 4**), and end-diastolic and end-systolic volume indices decreased from  $203 \pm 43$  to  $103 \pm 25$  ml/m<sup>2</sup>, and from  $164 \pm 39$  to  $70 \pm 25$  ml/m<sup>2</sup>, respectively, at the second postoperative week (**Fig. 5**). During the follow-up period of a mean of 8.1 months (1–18 months), 6 patients underwent postoperative left ventriculography by cine magnetic resonance imaging (MRI) and/or ultrafast emission beam computed tomography (Imatron) at 1 year after the operation, when no redilatation of the left ventricle was noted (**Fig. 6**). Improved synchronicity was noted

**Table 4 Outcomes of Batista operation**

Preoperative clinical condition	No. of patients	Hospital death	Late death	Survivors
Non-catecholamine dependent →elective operation	13	1 (7.7%)	2 (15.4%)	11 (84.6%)
Catecholamine dependent →elective operation	10	1 (10.0%)	1 (10.0%)	8 (80.0%)
Shock/pulmonary edema →urgent/emergent operation	7	6 (85.7%)	0	1 (14.3%)

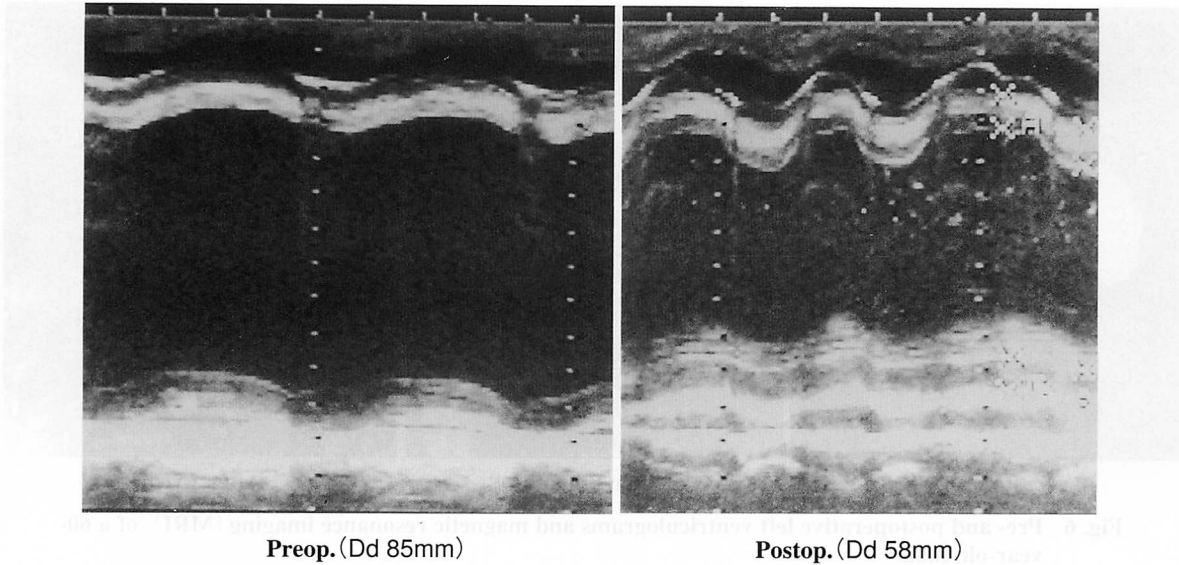


**Fig. 3 Left ventriculograms before and after the Batista operation in a 24-year-old man**  
*Left:* The huge left ventricle with mitral regurgitation is in NYHA class IV. Preoperative ejection fraction (EF) is 17%.  
*Right:* Postoperative ejection fraction increased to 34% with normal ellipsoid shape after operation. The patient returned to NYHA class I.  
 Abbreviation as in Table 2.

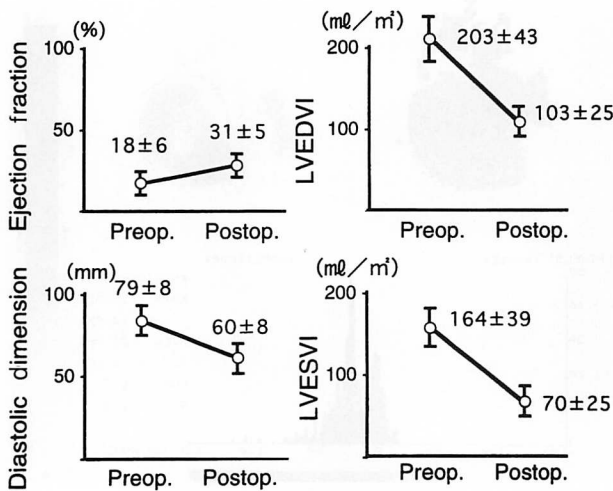
by histograms in multigated acquisition technique (MUGA) scanning (Fig. 7). Increased wall thickness of the left ventricle was observed by MRI ventriculogram (Fig. 8).

**DISCUSSION**

The Batista operation is designed to reduce the diameter of the left ventricle by excising a sizable



**Fig. 4** Pre- and postoperative echocardiograms of the patient shown in Fig. 3  
Dd = diastolic dimension.



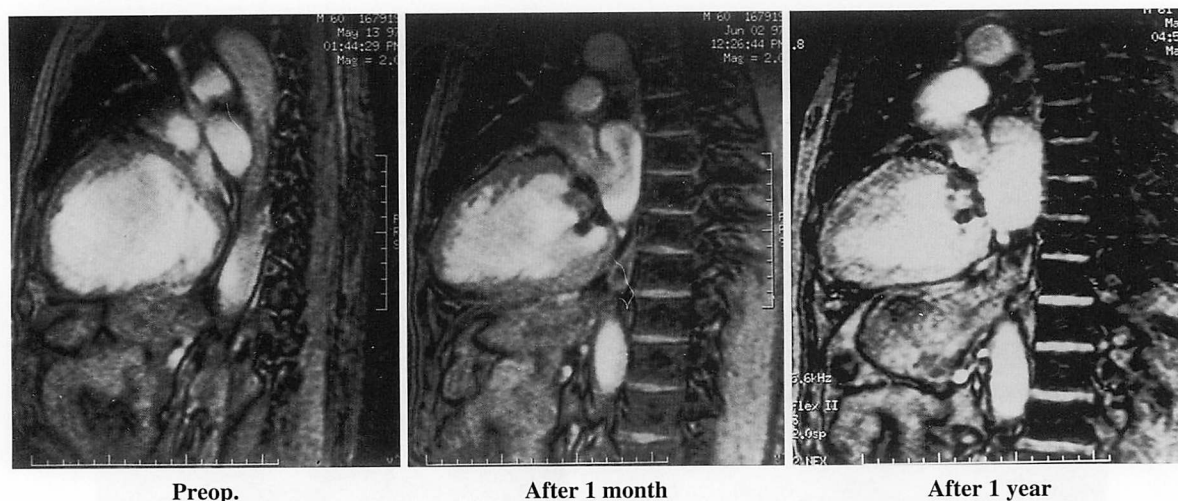
**Fig. 5** Changes in cardiac parameters after the Batista operation  
LVEDVI = left ventricular end-diastolic volume index ;  
LVESVI = left ventricular end-systolic volume index.

amount of left ventricular free wall, and is a unique surgical procedure for the treatment of end-stage dilated cardiomyopathy. While this procedure has gained keen attention from cardiologists and cardiac surgeons, little is known about proper selection of patients, late outcome and precise mechanism of changes in cardiac performance after the operation.

Batista<sup>1)</sup> explains that the mechanism of cardiac improvement totally depends on LaPlace's law. Left ventricular wall tension is decreased by reducing the diameter and then ejection fraction increases. Questions, however, still remain on diastolic function, preoperative judgement of left ventricular

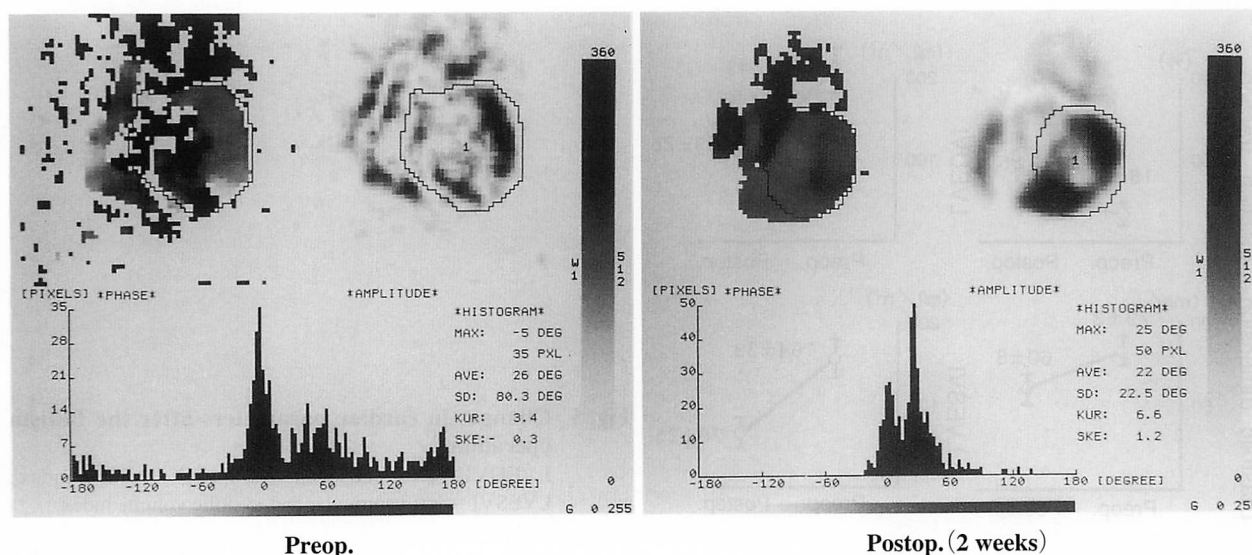
wall characteristics and late redilatation of the left ventricle.

Batista, Salerno and colleagues<sup>4)</sup> have shown their recent surgical results in 120 patients. Their cases included several types of ischemic and non-ischemic cardiomyopathy and very sick patients who were supposed to be non-candidates for cardiac transplantation were enrolled. Their 30 days mortality was 22% and 2-year survival was 55%. Postoperative NYHA class was I in 57%, II in 33% and no improvement in 10% among survivors. McCarthy and colleagues<sup>5)</sup> reported Cleveland Clinic experience in 53 patients. Most had idiopath-



**Fig. 6** Pre- and postoperative left ventriculograms and magnetic resonance imaging (MRI) of a 60-year-old man

The left ventricle became downsized by partial ventriculectomy with mitral valve replacement. At postoperative 1 year, no cardiac redilatation is noted.



**Fig. 7** Histograms in MUGA scanning of a 38-year-old man

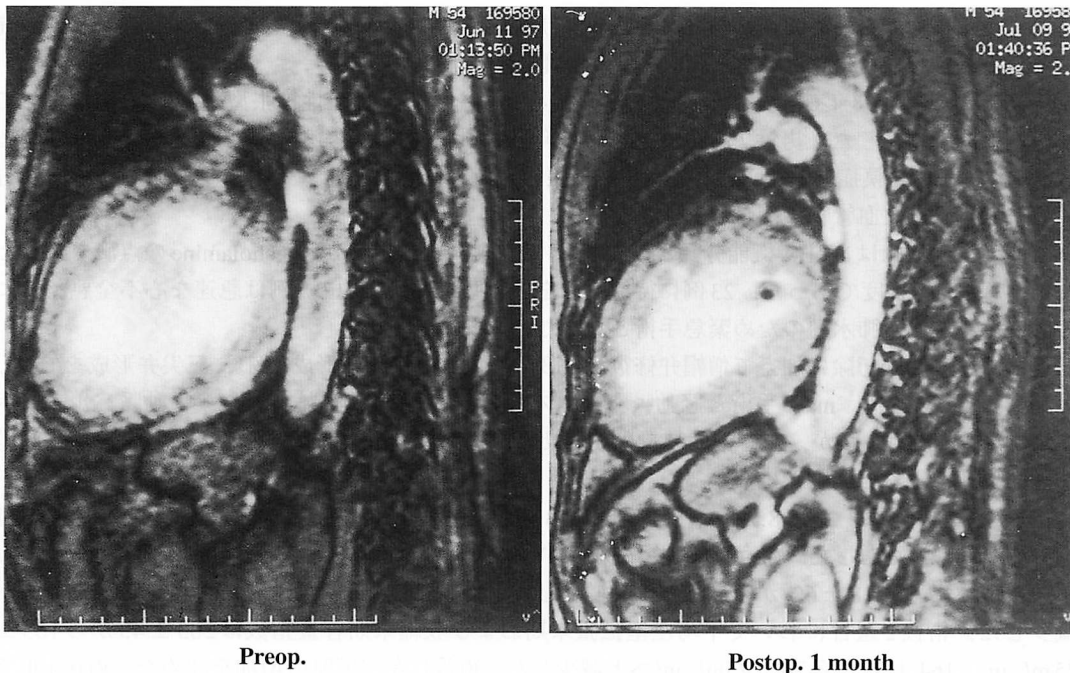
Improved synchronicity in the left ventricular contraction after the Batista operation is noted.

ic DCM and were candidates for cardiac transplantation. The 11-month actuarial survival was 87%, which is similar to that of cardiac transplantation. The postoperative NYHA class was I in 35%, II in 32%, and III in 27%.

Moreira and colleagues<sup>6)</sup> reported 27 patients who underwent PLV for idiopathic dilated cardiomyopathy. Of these, 4 patients had PLV alone and the remaining 23 had PLV with mitral valve plasty. In-hospital mortality was 14.8% and

7 patients died later due to heart failure or arrhythmia, so the survival rate was 59% between 6 and 24 months follow-up.

In our series, 23 patients including 10 with inotropic medication support were operated electively and early and late mortality were 8.7% and 13.0%, respectively, and 84.2% (16/19) of survivors returned to NYHA class I–II. On the other hand, only one of 7 patients survived who underwent emergency operation due to pulmonary edema



**Fig. 8** Left ventriculograms before and after the Batista operation of a 54-year-old man  
MRI reveals increased left ventricular wall thickness after the Batista operation.  
Abbreviation as in Fig. 6.

or cardiac arrest. Clearly none of these on-going shock patients will survive without aggressive surgical treatment, but this high surgical mortality rate suggests that this group of patients should be treated by left ventricular assist device first if available.

Improvement of left ventricular ejection fraction obtained in our series was similar to the reported results<sup>5,6</sup>. Increased thickness of the left ventricular wall was observed postoperatively (Fig. 8). No signs of left ventricular redilatation were found at one-year follow-up.

We preferentially selected patients with non-ischemic cardiomyopathy, mostly idiopathic DCM. For ischemic cardiomyopathy, we apply the Dor's ventriculoplasty<sup>7,8</sup> because exclusion of the akinetic septum caused by myocardial infarction is technically easier by endoventricular circular patch plasty.

Bolling and colleagues<sup>9</sup> treated 48 cases of

severe mitral regurgitation with DCM by only mitral annuloplasty and reported one operative death and 10 late deaths, and the one- and 2-year actuarial survival rates were 82% and 71%, respectively. However, better decision making whether to perform PLV in these cases is not scientifically established yet. We certainly need proper methods to differentiate the patients for valvular reconstruction alone and additional PLV.

In conclusion, the Batista operation is effective for non-ischemic dilated cardiomyopathy. Risk of operation is acceptably low in elective operation, but the risk is very high when the patients are in a shock state. Therefore, proper selection of patients and timing of the operation is critically important to obtain a successful outcome in the Batista operation.

## 要 約

### 非虚血性心筋症に対する Batista 手術 2 年間の成績

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内科的治療が限界に達し末期的心不全を呈する拡張型心筋症 (DCM) に対して、心室縮小手術

(Batista手術)は、内科治療と臓器置換というかけ離れた大きなギャップを埋める一つの新しい治療法として登場した。自験例をもとに2年間の成績を報告する。

1996年12月-1998年6月の19ヵ月間に、重症心不全を伴う非虚血性拡張型心筋症30例に対してBatista手術を施行した。男性25例、女性5例、年齢は14-67歳(平均47歳)、22例が特発性拡張型心筋症、3例が弁膜症、2例が肥大型心筋症拡張相、その他心筋サルコイドーシス、不整脈原性右室心筋症、修正大血管転移症、各1例であった。

術前の臨床症状はNYHA機能分類Ⅳ度が21例で、そのうち17例がcatecholamineの点滴を必要とし、残る9例がⅢ度であった。23例に待機手術を施行しえたが、他の7例は急速な心不全悪化による心停止あるいは肺水腫のため緊急手術となった。

手術は左室部分切除に加えて僧帽弁修復を26例(弁置換19例、弁形成7例)、三尖弁形成を15例、大動脈弁置換を3例、maze手術と冠動脈バイパス術をそれぞれ1例に施行した。大動脈バルーンポンプを6例に使用したが、左心補助装置は使用せず、全例体外循環より離脱しえた。術後、左心室からの出血による再開胸例はなかった。

待機手術23例中、2例(8.7%)が院内死亡、3例(13.0%)が遠隔死亡した。緊急手術7例中6例(85.7%)が院内死亡した。生存19例中16例がNYHA分類Ⅰ-Ⅱ度に改善し、3例がⅢ度であった。平均左室駆出率は $18 \pm 6\%$ から $31 \pm 5\%$ へ増加し、平均左室拡張末期径は $79 \pm 8$ から $60 \pm 8$ mmへ減少した。術後2週目において平均左室拡張末期および収縮末期容量指数は $203 \pm 43$ から $103 \pm 25$ ml/m<sup>2</sup>、 $164 \pm 39$ から $70 \pm 25$ ml/m<sup>2</sup>へと減少した。術後に左室壁厚の増加を認めた。術後1年で左室造影を行いえた6例で、左室機能の低下ならびに左室の再拡大は認めなかった。

以上より、Batista手術によって非虚血性拡張型心筋症の左心機能と臨床症状の改善が期待出来る。しかし、術前長期にわたってcatecholamineに依存する状態で、特に急激な心機能の悪化のために緊急手術となる症例での救命率は、現状においては極めて低い。このことから、本手術の効用を外科・内科がお互いによく理解して、適切なタイミングでBatista手術の適応を判断することが、今後の成績向上の鍵である。

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