

## Changes in the Plasma Levels of ANP, BNP, and Adrenomedullin after Left Ventriculoplasty

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### Introduction

On the basis that a marked increase of preload due to dilatation of the heart is a cause of the deterioration of cardiac function, surgical reduction of left ventricular size (Batista's procedure) is expected to improve cardiac function by decreasing the internal diameter of the left ventricle<sup>1~3)</sup>. Plasma levels of atrial natriuretic peptide (ANP)<sup>4~6)</sup>, brain natriuretic peptide (BNP)<sup>7~11)</sup> and adrenomedullin (AM) are reported to reflect the severity of cardiac failure and its prognosis. The effect of Batista's procedure on ANP, BNP or AM has not been reported previously. Here we report the postoperative course of a patient who underwent this operation for the treatment of dilated cardiomyopathy.

**Key words** : Left ventriculoplasty, ANP, BNP, Adrenomedullin

### Case report

The patient was a 61-year-old woman with a height of 153 cm and a weight of 43 kg.

**Present illness:** She had been treated for 6 year history of asthma because of cough. 1 year before admission, she was admitted to a local clinic as an emergency for nocturnal dyspnea. By myocardial

biopsy, she was diagnosed as having dilated cardiomyopathy. Oral administration of digitoxin, enalapril, and warfarin was started, but conservative treatment gradually failed to show efficacy and surgical reduction of the left ventricle was scheduled at the Department of Thoracic Surgery of our hospital.

**Past history:** In this April, she developed drowsiness and was diagnosed as having cerebral infarction. However, she recovered without leaving any neurological deficits.

**Condition at admission:** The blood pressure was 110/60 mmHg, the heart rate was 90 bpm, and the NYHA class was IV.

**Preoperative examinations :** The chest x-ray film showed protrusion of the right second arch and the left third and fourth arches, and expansion of the cardiac shadow with a cardiothoracic ratio of 68%. On cardiac catheterization, the aortic pressure was 120/66 mmHg, the pulmonary artery pressure was 38/16 mmHg, the pulmonary arterial wedge pressure was 17 mmHg, and the cardiac index was 3.45 l/min/m<sup>2</sup>. The left ventricular ejection fraction (LVEF) was 10% and diffuse marked hypokinesia of the left ventricular wall was observed.

### Intraoperative and postoperative course

After induction of anesthesia, the cardiac index obtained by the thermodilution method was 2.5 l/min/m<sup>2</sup> and the LVEF measured by transesophageal echocardiography was 18%. Left ventriculoplasty was finished after 48 minutes, and weaning from the

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cardiopulmonary bypass was easily achieved with administration of 10  $\mu\text{g}/\text{kg}/\text{min}$  of dopamine and 10  $\mu\text{g}/\text{kg}/\text{min}$  of dobutamine.

On transesophageal echocardiography after removal of the cardiopulmonary bypass at the end of operation, an improvement of cardiac function was found (Table

**Table 1. Changes in cardiac performance determined by transesophageal echocardiography**

	Pre CPB	Post CPB
EF(%)	18	31
%FS(%)	8	15
LVDd(mm)	85.1	67.4

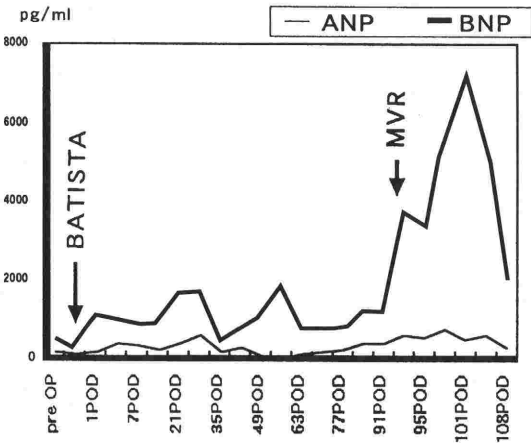
: abbreviation : EF: Ejection fraction, FS: fractional shortening, LVDd: Left ventricular diastolic diameter, CPB: Cardio pulmonary bypass

1). The chest x-ray film taken shortly after surgery showed that the cardiothoracic ratio decreased to 56%. The patient awoke 4 hours after transfer to ICU and the tracheal tube was removed without any problems on the next morning. She was easily weaned from catecholamines and was discharged from ICU on the fifth postoperative day (POD). The course thereafter was favorable, and the patient became able to walk in her ward. However, on the 21st POD, cardiac failure recurred, and on the 35th POD, administration of DOA became necessary. Echocardiography revealed Grade III mitral regurgitation and cardiac dilatation. On the 92nd POD, mitral valve replacement was performed for the treatment of mitral regurgitation. After the second operation, the patient was returned to ICU under circulatory support by an intraaortic balloon pump (IABP). The IABP was removed later, but she died of multiple organ failure associated with cardiac failure and septicemia on the 111th POD. The blood levels of ANP, BNP, and adrenomedullin, as well as hemodynamics observed in the perioperative period, are shown in Fig. 1 and 2.

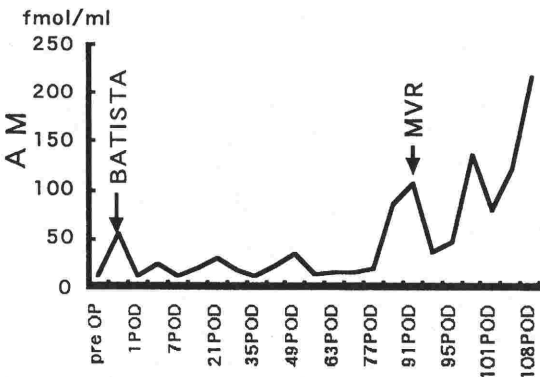
**Discussion**

Surgical reduction of left ventricular size by Batista's procedure involves resection of part of the left ventricular free wall and reduction of the internal diameter of the ventricle with simultaneous valvoplasty. This is done to improve cardiac function based on the assumption that the cause of functional deterioration is a remarkable increase of preload due to dilatation of the cardiac chambers.

Batista has performed this operation on more than 400 patients, achieving a hospital survival rate of 85%, a 1-year survival rate of 65%, and symptomatic improvement of cardiac failure in 70%<sup>1)</sup>. Batista's procedure has been applied for DCM in recent years, and has achieved a 1.5- to 2-fold increase in EF and improvement of cardiac function<sup>2,3)</sup>. Early death after this operation has been attributed to dysfunction of other vital organs<sup>2)</sup>. In our case, the LVEF was improved from 18% to 31% on echocardiography shortly after operation. However, cardiac failure recurred owing to mitral regurgitation and surgery had



**Fig 1. Changes in plasma concentrations of ANP and BNP**



**Fig 2. Changes in plasma concentrations of adrenomedullin**

to be performed again.

Plasma levels of atrial natriuretic peptide (ANP)<sup>4~6</sup>, brain natriuretic peptide (BNP)<sup>7~11</sup> are reported to reflect the severity of cardiac failure and its prognosis. ANP is mainly produced in the atrium and BNP in the ventricles, while AM is produced by vascular endothelial cells throughout the body. It is considered that these hormones are secreted as a compensatory reaction to blood pressure elevation and fluid accumulation. In particular BNP secretion is enhanced by ventricular loading, and BNP is the most sensitive index of left ventricular function. The effect of Batista's operation on ANP, BNP or AM has not been reported previously. The survival rate of cardiac failure patient with an ANP level of more than 180 pg/ml (normal value: 43 pg/ml or less) and a BNP level over 200 pg/ml is low (normal value: 18.4 pg/ml or less)<sup>12</sup>, and setting the target BNP level at less than 200 pg/ml in the treatment of cardiac failure is said to be preferable. In the present patient, the preoperative ANP level was 190 pg/ml and the BNP level was an extremely high 510 pg/ml. Although the BNP level temporarily decreased to 300 pg/ml after first operation, it never fell below 200 pg/ml. On the 21st POD when cardiac failure developed, BNP was 1600 pg/ml, and it rose greatly to 8200 pg/ml in the terminal stage of cardiac failure, well reflecting the severity of the patient's cardiac failure.

AM is a peptide with a strong vasodilatory effect that was found in a pheochromocytoma in 1993<sup>13</sup>, and its involvement in cardiac failure has been reported<sup>14~18</sup>. In the present patient, the blood AM level showed changes that corresponded to the changes of ANP and BNP, and it rose remarkably (217 fmol/ml) in the terminal stage of cardiac failure similarly to ANP and BNP. This elevation may be seen as an attempt to decrease afterload when cardiac failure worsened.

Treatment of DCM by Batista's procedure clearly improves cardiac function, and therefore is effective and its use as bridge treatment before transplantation can be justified. The levels of ANP, BNP, and AM before and after ventriculoplasty showed changes

corresponding to the symptoms of cardiac failure in our patient, suggesting a relationship of these hormones to the severity of cardiac failure.

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