ABSTRACT: Early postoperative left ventricular function was investigated in 42 patients with left ventricular volume overload caused by valvular regurgitation. Preoperatively, left ventricular contractile function, stroke work and stress relations were all evaluated. Anoxic index (AnI) was considered as an index of myocardial preservation. Postoperatively, the cardiac function was estimated as the left ventricular stroke work index (SWI) after 3, 6, 24 and 48 hours of post-cardiopulmonary bypass. The release of CK-MB isoenzyme was also measured at the same time as an indication of myocardial injury. AnI and the postoperative SWI₃ and SWI₆ showed negative correlations in 6 hours, while preoperative SWI₀ and postoperative SWI₂₄ and SWI₄₈ showed positive correlations after 24 hours, and SWI₀ showed positive or negative correlations to the preoperative 8 parameters. It was observed that ejection fraction, end-systolic wall stress to end-systolic volume index ratio and tension volume ejection showed positive, while left ventricular end-diastolic pressure showed negative correlations to SWI₄₈. However, none of these indexes showed any significant correlations during the first 24 hours following surgery. On the other hand, AnI and the total release of CK-MB isoenzyme showed a positive correlation. These data suggest that the cardioplegic baneful effect on cardiac function might be lost in the first 24 hours after surgery.

KEY WORDS: valvular heart disease, postoperative left ventricular function, myocardial preservation, anoxic index

INTRODUCTION

Cold cardioplegic technique is the universal method for myocardial preservation in open heart surgery. However, cold and reperfusion injuries reduce the postoperative left ventricular function in the early stage, and
tricular pump performance in the early postoperative stage with reference to intraoperative myocardial preservation and preoperative cardiac function. During a certain period, the early postoperative function might decrease in proportion to the degree of cardiac damage and after that period, postoperative proper cardiac function may be obtained in proportion to the level of preoperative performance. We detected the reverse period of correlation with postoperative cardiac function from cardioplegic baneful effect to preoperative original cardiac function.

MATERIALS AND METHODS

Patients
From 1983 to 1988, 42 patients with volume overload caused by valvular regurgitation underwent prosthetic cardiac valve replacement at Yamagata University Hospital. The patients comprised 26 males and 16 females with a mean age of 52 ± 11 (m ± SD) years and a mean period of preoperative medical therapy of 24 ± 22 months. Thirty-six per cent of the patients had atrial fibrillation and 4 patients had suffered infectious endocarditis. There was one case of early death and another of late death.

Operative procedure
Eleven patients underwent aortic valve replacement (AVR), 2, Cabrol's operation, 2, AVR with mitral valve repair, 17, mitral valve replacement (MVR), 4, MVR with tricuspid valve annuloplasty (TVA), 1, MVR and left atrial plication, 4, aortic and mitral valve replacement (DVR), and 1, DVR with TVA. Cardiopulmonary bypass (CPB) was performed for 159 ± 65 minutes. The ascending aorta was cross-clamped for 104 ± 37 minutes and the lowest rectal temperature recorded was 25.8 ± 1.4°C during aortic occlusion. Multiple doses of a crystalloid cardioplegic solution were infused into the aortic root or directly into the coronary ostia. The mean myocardial temperature with topical cooling was 13.0 ± 3.8°C during the cross-clamp period and the mean bypass flow was 2.3 ± 0.1 l/min/m². The implanted mechanical valves used were; St. Jude Medical in 8 patients, Medtronic Hall in 10 and Björk-Shiley valved conduit for 2 aortic positions, and Medtronic Hall for 27 mitral positions. Tricuspid annuloplasty was performed in 2 patients with Carpentier-Edwards' ring and in 3 with DeVega's procedure.

Measurements
Preoperatively, all patients underwent bilateral cardiac catheterization, ventriculography and measurement of cardiac output by the dye dilution method in a standard fashion. Left ventricular stroke work index (SWI) was calculated from the stroke volume index (SVI), the mean pressure of ascending aorta (mean AoP) and the mean pulmonary capillary wedge pressure (mean PCWP) by the formula SWI=SVI X (mean AoP - mean PCWP) X 0.0136. Left ventricular volume was evaluated by Dodge's area-length method and the mean velocity of circumferential fiber shortening was followed by Karliner's procedure. End-systolic wall stress was obtained by Mirsky's formula. The mean value of five or six cardiac cycles was taken for the patients with atrial fibrillation. Preoperative cardiac function was represented as follows; left ventricular stroke work index (SWI), end-systolic volume index (ESVI), ejection fraction (EF), mean velocity of circumferential fiber shortening (mean VCF), fractional shortening (FS), left ventricular end-systolic pressure to end-systolic volume index ratio (ESP/ESVI), end-systolic wall stress to end-systolic volume index ratio (ESWS/ESVI), tension volume ejection fraction (TVEF) and left ventricular end-diastolic pressure (LVEDP).

Intraoperatively, a myocardial temperature sensor was inserted into the interventricular septum from the apex to a depth of about one centimeter, enabling intramyocardial temperature to be monitored during the aortic cross-clamping period. Anoxic index (AnI) was used as an improved index of