Aortic Valve Replacement Combined with the Endoventricular Patch Technique for Aortic Valve Stenosis Complicated by Ischemic Heart Disease

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The indication for aortic valve replacement (AVR) combined left ventricular (LV) plasty in the patient with aortic valve stenosis (AS) complicated by ischemic heart disease is controversial. We describe a case of AS with ischemic heart disease of a patient who underwent a successful surgical treatment, AVR combined with the endoventricular patch technique. The patient was an 82-year-old woman who suffered from heart failure, New York Heart Association (NYHA) class III. The heart failure derived from AS and ischemic heart disease with severely compromised LV function. She underwent AVR combined with the endoventricular patch technique and the postoperative course was uneventful. She has been well with NYHA class I for about 5 years after the operation without heart failure.

Keywords: aortic valve replacement, aortic valve stenosis, the endoventricular patch technique, ischemic heart disease

Introduction

The surgical treatment for patients with aortic valve stenosis (AS) complicated by coronary artery disease (CAD) is generally coronary artery bypass grafting (CABG) and aortic valve replacement (AVR),1) however, in considerable patients with low left ventricular ejection fraction (LVEF), AVR results in little improvement in cardiac function, postoperative high mortality and congestive heart failure (CHF).2) The therapeutic strategy for severe AS complicated by ischemic heart disease is controversial, and there are few reports about it.3) We describe a patient with successful surgical treatment, specifically AVR combined with the endoventricular patch technique, for AS complicated by ischemic heart disease.

Case Report

The patient was an 82-year-old woman. She was admitted to our hospital in 1995 for acute myocardial infarction when she was 72 years old. She underwent percutaneous coronary intervention (PCI) to left anterior descending artery (LAD) and successful recanalization was accomplished. However, the left ventriculogram demonstrated akinesis at the anteroseptal and apex wall. She had been followed with medication and diagnoses of ischemic heart disease and mild AS. In May 2005, she complained of chest discomfort on mild effort in the house, dyspnea at night and general fatigue, New York Heart Association (NYHA) class III. A twelve-lead electrocardiogram showed abnormal Q wave and T wave elevation in V2-V5. A chest radiograph demonstrated cardiomegaly with a cardiothoracic ratio of 0.59 and mild pulmonary congestion. An echocardiograph revealed an aneurysmal left ventricle (LV) at the apex,
severe hypokinesis or akinesis at the anteroseptal wall. Cardiac catheterization performed in June 2005 showed a pulmonary arterial mean pressure of 17 mmHg, a pulmonary capillary wedge pressure of 13 mmHg, a left ventricular systolic pressure of 171 mmHg, a left ventricular end-diastolic pressure of 15 mmHg, and an ascending aortic systolic pressure of 100 mmHg. Pressure gradient across the aortic valve was 71 mmHg, and aortic root angiography demonstrated grade 1 regurgitation. Left ventricular end-diastolic volume index (LVEDVI) was 124 ml/m$^2$, left ventricular end-systolic volume index (LVESVI) was 82 ml/m$^2$, and left ventricular ejection fraction (LVEF) was 34% (Fig. 1). Mitral regurgitation was trivial. A coronary angiogram showed that there were no significant stenoses in the coronary artery containing the LAD with PCI stent.

The operation was performed with cardiopulmonary bypass under mild systemic hypothermia. After the cross-clamping of the distal ascending aorta, cardiac arrest was accomplished by initial antegrade cold blood cardioplegia via the aortic root and continuous retrograde cold blood cardioplegia. The surgery revealed a calcified aortic valve with severe thickness and retraction, and an aneurysmal dilatation of the left ventricle located on the anterior-apical portion. The aortic valve was excised and replaced with a stented bioprosthetic valve (Carpentier-Edwards Biophysio Pericardial Aortic Bioprosthesis, Edwards Life-sciences, Irvine, CA, USA) and a left anterior ventriculotomy was made parallel to the LAD. A continuous suture was placed in the scar along the edge of normal left ventricular wall and tied to create a purse-string effect. A heterologous pericardial patch preserved by a glutaraldehyde chemical fixation process was tailored in a round shape of 3.5 × 3.5 cm. The pericardial patch was sutured with several horizontal mattress suture along the purse-string suture line. The sutures were brought outside the heart on the free wall of the LV and inside the heart on the septal wall side. The interrupted mattress suture on the free wall and posteroinferior wall of the LV were placed sequentially through a piece of Teflon felt on the epicardial surface of the LV, left ventricular wall, a heterologous pericardial patch on endocardium, and on the septal wall side sequentially taking deep bites of endocardial wall tissue. The ventriculotomy was closed using buttress sutures with a Teflon felt strip on either side of the incision (Fig. 2). The patient was smoothly weaned from cardiopulmonary bypass. The duration of cardiopulmonary bypass and aortic cross clamp was 179 minutes and 126 minutes, respectively. The postoperative course was uneventful and she was discharged on the 26th postoperative day. Postoperative cardiac catheterization performed approximately three years after the operation demonstrated pulmonary arterial mean pressure of 15 mmHg, pulmonary capillary wedge pressure of 15 mmHg, LVEDVI of 80 ml/m$^2$, LVESVI of 40 ml/m$^2$, and LVEF of 50% (Fig. 3). The patient has been well with NYHA class I for about 5 years after the operation without heart failure.

Discussion

Severe AS with CHF carries a dismal prognosis, and
the interval from the onset of CHF for AS to the time of
death is approximately 2 years without surgical therapy. AVR for symptomatic AS is the only effective treatment, however the operative risk increases in the presence of left ventricular systolic dysfunction, and left ventricular dysfunction is a major prognostic indicator of the outcome of patients undergoing AVR for AS. Hwang et al. reported that in patients with AS preoperative ejection fraction was the strongest predictor of postoperative left ventricular dysfunction, followed by previous myocardial infarction, lower aortic valve gradient, and incomplete coronary revascularization. Connolly et al. demonstrated that 30-day mortality in AVR for AS was related to the presence of significant CAD and that late mortality was also related to the presence of significant CAD in addition to preoperative cardiac output. Improvement of symptoms or left ventricular function, as well as prolongation of survival, are acceptable indications for the operation. The indication for AVR in our present patient is controversial due to the concomitance of significant CAD, preoperative low cardiac function, and high age.

Operation for ischemic left ventricular aneurysm (LVA) is indicated for symptoms of angina, CHF, or selected ventricular arrhythmias. For these symptomatic patients, surgical therapy offers better outcome than medical therapy. Patients with a dyskinetic or akinetic

Fig. 2 (a) The interrupted mattress suture on the free wall and postero-inferior wall of left ventricle (LV) were placed sequentially through a Teflon felt on the epicardial surface of the LV, left ventricular wall, a heterologous pericardial patch on endocardium, and on the septal wall side sequentially taking deep bites of endocardial wall tissue. (b) The ventriculotomy was closed using buttress sutures with a Teflon felt strip on either side of the incision.

Fig. 3 Postoperative left ventriculogram. Left ventricular ejection fraction (LVEF) was 50%. (a) diastole, Left ventricular end-diastolic volume index (LVEDVI) was 80 ml/m². (b) systole, left ventricular end-systolic volume index (LVESVI) was 40 ml/m².
LVA and a significantly enlarged LVESVI (over 80 ml/m²) and LVEDVI (over 120 ml/m²) would benefit from having an operation. Our present case, one with akinetic LVA, met these criteria. Dor and colleagues demonstrate that dyskinesia is not a prerequisite for aneurysm repair because results are not affected by whether aneurysms are akinetic or dyskinetic.\(^{11,12}\)

In the present patient, we adopted the strategy for AVR combined with LV plasty for AS complicated by ischemic heart disease because of the recent improvement of operative outcome in AVR for AS or LV plasty for ischemic heart disease, local ischemic heart disease, and CHF for both AS and LVA. The aortic valve was replaced with a bioprosthetic valve and the LV plasty was performed with the endoventricular patch technique. Concerning the technique, the interrupted mattress suture along the purse-string suture line was performed transmurally on the free wall and taking deep bites of endocardial wall tissue on the septal inside wall. In our method a pericardial patch is fixed tightly on the endocardium with the interrupted mattress suture, therefore our technique may reduce the risk of residual leakage. Dor et al.\(^ {13}\) showed in a report, endoventricular patch plasty for ischemic left ventricle, that only 4 patients underwent AVR as an associated procedure among 781 patients with the left ventricular plasty. The operative indication of AVR with concomitant left ventricular reconstruction should be examined sufficiently for pathophysiology and background of the patient.

**Conclusion**

We reported a case of AS complicated by ischemic heart disease with severe LV dysfunction. The patient underwent a successful surgical treatment, AVR combined with the endoventricular patch technique, and lives without heart failure in the long term.

**References**