The CardioWest Total Artificial Heart for Chronic Heart Transplant Rejection

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Mechanical circulatory support has been used to treat graft failure after heart transplantation, but in patients who needed mechanical circulatory support because of chronic rejection, we have suffered from the treatment because its outcome was catastrophic. Multiple organ failure was often caused by the addition of or increase in immunosuppressive medications, and it is known as a cause of the poor outcomes. The CardioWest total artificial heart was implanted for a case of chronic heart transplant rejection to enable complete withdrawal of immunosuppressive medication. The patient underwent re-heart transplantation, with a good result. This is a new therapeutic technique for chronic graft rejection. (Circ J 2009; 73: 1167–1168)

Key Words: Chronic heart transplant rejection; Mechanical circulatory support; Total artificial heart

Heart transplantation is still considered as the most effective surgical therapy for end-stage heart failure, but infection and rejection are still serious complications. Primary graft failure is treated by mechanical circulatory support, whereas rejection or graft failure caused by rejection is treated by the addition of or increases in immunosuppressive medications. We have implanted ventricle assist devices (VADs) in patients who have developed right ventricular failure, acute rejection, or chronic graft failure after orthotopic heart transplantation, but patients’ outcomes, especially of those supported with VAD because of chronic graft failure, were catastrophic. Many patients died from multiple organ failure (MOF), which was caused by immunosuppressive therapy, despite having stable hemodynamics.

We tried a new therapy for chronic graft failure in which the donor heart with graft failure is removed and the patient receives circulatory support with an artificial heart, with the aim of complete withdrawal of immunosuppressive medication. We had a good result and our findings are reported here.

Case Report

A 40-year-old woman had developed chronic rejection 7 years after heart transplantation for dilated cardiomyopathy. We had instituted immunosuppressive therapy based on initial triple-drug therapy (cyclosporin, prednisolone, and azathioprine). The coronary angiogram showed multiple stenosed lesions in the left circumflex (LCX) artery and a diffuse concentric narrowing lesion in the left anterior descending artery (LAD). Intravascular ultrasonography showed that the intima in both the LAD and LCX was 1 mm thick and involving more than half of the vessel’s circumference. The left ventricle (LV) had widespread hypokinesia.

Despite additional immunosuppressive therapy with FK506 and rapamycin, the patient developed acute renal failure, defined as a creatinine (Cr) level of 4.5 mg/dl and blood urea nitrogen (BUN) level of 98 mg/dl. In addition, she required hemodialysis. Liver dysfunction, defined as a total bilirubin (T-bil) level of 1.8 mg/dl, a glatamic oxaloacetic transaminase (GOT) level of 240 U/L, and a glutamic pyruvic transaminase (GPT) level of 338 U/L, was also detected. Because graft failure and low output syndrome had developed consecutively, circulatory support with a biventricular assist device was performed using a centrifugal pump (Bio-Medicus BP-80; Medtronic-BioMedicus, Eden Prairie, MN, USA). Although her hemodynamic status was maintained at a stable level, the donor heart showed no signs of recovery, indicating the need for long-term mechanical circulatory support and immunosuppressive therapy.

We decided to remove the donor heart and implant the CardioWest total artificial heart (TAH) (SynCardia Systems, Tucson, AZ, USA). The rejected transplanted heart was removed from the aorta, the pulmonary artery, both atrial walls, and the atrial septum to restore the pretransplantation state. The technique used for the CardioWest TAH implantation were similar to methods described by Arabia et al.

After the operation, the patient was in a hemodynamically stable condition. The central venous pressure was 6–8 mmHg, the flow in the left VAD was 5–6 L/min, and that in the right VAD was 4–5 L/min. Hepatic and renal functions recovered.

Anticoagulation, which consisted of phenprocoumon and clopidogrel bisulfate, was set at an international normalized ratio of 2.5–3.5. After implantation of the TAH, there were no complications (ie, thromboembolism, hemorrhage, infection).

The patient received no immunosuppressive therapy and underwent repeat heart transplantation 10 months after TAH.

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implantation.

**Discussion**

Mechanical circulatory support after orthotopic heart transplantation is used to treat right heart failure, acute rejection, primary graft failure or chronic graft failure caused by graft vasculopathy. In cases of chronic graft failure, patients do not recover despite the addition or changing of immunosuppressive medications. The surgical treatments for chronic graft failure are percutaneous transluminal angioplasty, coronary bypass grafting, transmyocardial laser revascularization, and repeat heart transplantation. However, cases of graft vasculopathy with diffuse distal obliteration and involvement of the intramyocardial branches are not amendable to percutaneous or surgical revascularization and in such cases retransplantation is the only definitive therapy.

Because of the shortage of donor hearts, patients who have chronic graft failure have to wait for a long time, as for primary heart transplantation, and they may need mechanical circulatory support as a "bridge to re-heart transplantation".

In our hospital, many patients who have been supported by several types of mechanical circulatory support have died of MOF, caused by the immunosuppressive therapy, and the prognosis remains poor.

Even when the patient’s hemodynamics are stabilized by mechanical circulatory support, we have had deaths from MOF resulting from the continual administration of immunosuppressive therapy for chronic rejection.

To solve these problems, we performed a new therapy in which we removed the donor heart with graft failure caused by chronic rejection, and implanted a TAH, which then allowed us to completely withdraw the immunosuppressive medication.

We have used various VADs and of them, the CardioWest TAH has proved to be effective for biventricular heart failure, with good results. Further, Copeland et al demonstrated that risk factors after CardioWest TAH implantation as a bridge to transplantation in biventricular heart failure patients, including those with irreversible cardiac rejection, were a history of smoking and prolonged prothrombin time, without including chronic heart transplant rejection.

As an advantage, the cardiac output of the CardioWest TAH is generally 7–8 L/min, which not only improves pressure and flow to end organs, but also increases the "washing" of the device’s surfaces that are in contact with blood, thus reducing the risk of thromboembolism. Our patient developed renal and liver dysfunction because of the immunosuppressive agents, but her renal function improved to within normal range (Cr 1.2 mg/dl, BUN 30 mg/dl, T-Bil 1.1 mg/dl, GOT 40 U/L, GPT 52 U/L) owing to the high blood flow by the CardioWest TAH and dialysis was not necessary.

Furthermore, since 2003, we have used portable pneumatic driver/consoles, which provide pneumatic power and give the patients increased mobility, so they can be discharged from hospital under careful management.

We believe that our new therapeutic technique is effective and beneficial for patients who have therapy-refractory rejection.

**References**