UDK 616.12-008.315:616.12-089
Review
Received: 3. November 2010
Accepted: 26. January 2011.

LONG-TERM MECHANICAL CIRCULATORY SUPPORT FOR PATIENTS WITH TERMINAL STAGE OF CONGESTIVE HEART FAILURE: A CASE REPORT

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Summary

Despite recent advances in treatment, the number of people with heart failure continues to grow; this is associated with high mortality and morbidity rates. Heart transplantation is very limited due to the lack of the adequate number of heart donors, and medical therapy remains palliative. He use of ventricular assist devices (VADs) has led to improved survival rates for patients with severe heart failure. Originally introduced as a temporary bridge-to-recovery, and later as a bridge-to-transplantation, VADs have evolved to permanent or destination therapy for patients with terminal stage of congestive heart failure[1]. In this paper, we report of our patient with dilatative cardiomyopathy, to whom – due to the end-stage heart failure, and for the first time in Croatia – a device for paracorporeal long-term mechanical left ventricular support (pVAD) was implanted.

Keywords: congestive heart failure; heart transplantation; mechanical circulatory support; left ventricular assist device (LVAD)

Introduction

Heart transplantation today has become a standard method of treatment for improving the quality and extending the life of patients in the terminal stage of systolic heart failure. However, due to the lack of adequate number of donors, heart transplantation is available only to a small number of such patients. In the last two decades, the development of mechanical circulatory support, i.e. devices for long-term paracorporeal mechanical left ventricular support, has significantly improved survival chances for patients with systolic heart failure. The mechanical support of

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the left heart (LVAD-left ventricular assist device) brings new possibilities into the treatment of terminal stage of congestive heart failure. The application of an LVAD was approved in the U.S. in 1994 as bridging to transplantation in individual critically ill patients [1]. Today it is applied in patients refractory to optimal medical therapy as a *bridge-to-transplantation*, as well as a *bridge-to-recovery*, and as a *destination therapy*. The key randomized study REMATCH (Randomized Evaluation of Mechanical Assistance for the Treatment of Congestive Heart Failure) concluded that mechanical circulatory support with pulsatile flow dramatically reduced the mortality by 48% in 129 patients who were not eligible for heart transplantation [2]. This paper surveys the patient with heart failure to whom for the first time in Croatia- a device for paracorporeal long-term mechanical left ventricular support was implanted.

Case report

The first Thoratec LVADs was implanted in a 41-year-old man with a history of dilatated cardiomyopathy, most probably due to myocarditis caused by cardiotropic viruses. Anamnestic data show as that at the beginning of 2007, he was suffering from heavy respiratory infection with fever, cataral symptoms and poor general condition, treated with azythromycin. During that year he was several times hospitalized on the grounds of cardiac decompensation, symptoms of dyspnea and intolerance to activity. In December 2007, echocardiograpy showed a global heart dilatation with severely reduced left ventricular ejection fraction (LVEF) of 20%, and severe mitral regurgitation. The right heart chateterisation showed moderate pulmonary hypertension PAP 35 mmHg, TPG 5 mmHg, RVSP 56 mmHg, pulmonary vascular resistance PVR 1,0 wood units, RVSW-I 8,05 gm^*m/m^2. Coronarography showed no significant coronary arteries disease. Due to terminal stage of congestive heart failure, patient was listed for heart transplant. In October 2008, invasive cardiac procedure was repeated, and it indicated progression of disease with LVEF 15%, and severe mitral regurgitation.

A team of cardiologists and cardiac surgeons recognized the patient as a candidate for LVAD implantation as a bridge-to-transplant. The procedure of LVAD implantation was successful, with normal patients postoperative recovery. For anticoagulant therapy, varfarin was used, ordinary INR controlling, with target value from 2.5 to 3.5, and antiplatelet therapy with aspirin 150 mg daily. After implantation of the mechanical assist device, clinical status of patient was progressively better. A control echocardiograpy indicated increase of LVEF on 32% with good contraction of the back wall of LV and minor mitral regurgitation. In December 2008, after physical rehabilitation, the patient was discharged home with LVAD.

After one month a device control was performed. In the patient, a brief eyesight failure with regular neurological status was noted. The head CT indicated ischemic vascular lesion near the occipital horn of the left lateral ventricul, showing that the patient was suffering from CVI caused by microembolism. The echocardiograpy proved regular function of the device without thrombotic mass. Further continuous echocardiograpy controls showed a significant improvement of global systolic function of left ventricular, LVEF 40 % with minimal aortic and mitral regurgitation with no significant pulmonary hypertension.

Four months after the LVAD implantation, we noted a significant improvement in LVEF and general condition. Due to a potential complication arising from the device usage, as a cerebrovasculary microembolism or infection, it was indicated to remove LVAD. An increase of LVEF to Teiholtz from 37% to 46% vs Simpson from 38% to 50%, was noted after a dobutamine stress testing. An excercise testing also was performed.

The explantation of LVAD was successfully performed in March 2009. The postoperative period was followed by subfebrility, an acute renal insufficiency and the retrosternal collecting of minor volume of liquid which was confirmed by MSCT examination of thorax. Hemocultures were positive to *Stenotropomonas maltophillia* and were successfully treated with systemic antibiotics. The renal function was substituted by hemodialysis. The operatition wound above the distal part of sternum was opened because of secretion, and it was treated daily and healed per secundam. The echocardiograpy revealed a dilatation of both ventricles, with a decrease of LVEF to 30% and RVEF to 35%, with moderate mitral regurgitation. Due to the medicament therapy, the patient was hemodynamically stabile and afebrile, and was hence discharged. The patient was feeling generally well until July 2009, when the symptoms of heart failure occurred. He was hospitalized in a poor general condition, with high temperature, a significant rash on the body and the extremities, with the staphylococci sepsis suspected. The laboratory tests indicated increased inflammation parameters, increased values of bilirubin, and positive hemoculture test to *Staphylococcus aureus*. Antibiotic treatment was prescribed. The progression of the end stage heart failure started in August 2009. The echocardiograpy proved massive mitral and tricuspid regurgitation on the basis of dilatation of ring, the dilatation of both ventricles with LVEF and RVEF of 15%. The patient became rhythmically and hemodynamically unstabile with the development of cardiorespiratory arrest. Upon applying all measurement of CPR and implantation of intraaortic balloon pump, the patient became stabile, and on the same day listed on the transplantation list with a high-urgency status. Eventually, the patient fell into a septic shock with a multi-organ failure, and despite the vasoactive and innotrop medicaments, the patient got into a cardiorespiratory arrest and died. The pathology examination confirmed septic shock as the cause of death.

The characteristics of the left ventricular assist device

Ventricular assist devices that are in use today differ by their basic mechanical characteristics; by the type of blood flow they create (continuous or pulsatile); by their positioning (intercorporal, paracorporal or extracorporal); and their ability to assist one or both ventricles.

In our case, Thoratec paracorporeal left ventricular assist device LVAD was used. Thoratec pVAD is a mechanical circulatory assist device to left ventricle, enabling pulsatile blood flow and consisting of three components: the device for blood, which has cardiac output of 65 mL and can produce a pulsatile flow of 1.3 to 7.1 L/min; the inflow and outflow cannula, which connects the device to the left ventricle and the aorta; and the external console, which starts the device pneumatically. The device is positioned paracorporeally, outside the body. The device can be used for the left or the right ventricular support or as a biventricular support for either a short or long term, or as destination therapy. It is necessary to use anticoagulant or antiplatelete therapy, because tromboembolism is associated with all devices.

Discussion

Heart failure continues to be a fatal disease, despite the advances in treatment, with only 35% surviving 5 years after the first diagnosis [3]. Systolic heart failure today is treated with medicaments, by heart transplantation or by a mechanical assist device, which has significantly improved treatment results and substantially changed the natural course of the disease. Only two researches have so far compared patients with advanced heart failure not eligible for transplantation, treated by optimal medicament therapy and mechanical circulatory support. The results of these researches have indicated that the survivals, the function capacity and the quality of life were notably better in patients treated with pulsatile mechanical heart support [3,4]. A wider use of mechanical assist devices is limited due to the price of the device; the size of the pump; possible complications; and the limited durability of the pump.

The indication for device therapy is the presence of heart failure in patients approved for transplantation [5]. As devices become more prominent, the indications expanded, so today, patients with acute decompensation of chronic heart failure; myocarditis; ventricular arrythmias; postcardiotomy failure; or acute myocardial infarction can be successfully treated with an assist device [6].

Patients to whom mechanical support is applied, are categorized in four groups. First group includes bridge-to-recovery patients, whose chances for recovery of function of the ventricle are significant as it is suffering from either a postcardiotomy shock or acute myocarditis. The second group includes patients, in whom

acute cardiogenic shock is developed in the institution not having transplantation or long term mechanical assist device possibilities. The group, in which VAD as a bridge-to-transplant is used, includes patients on the list for heart transplantation, where mechanical support is used for the stabilisation of hemodinamical status. The fourth group includes patients, for whom the mechanical assist device is a destination therapy. The removal of LVAD can be considered once the heart function is significantly recovered.

In our patient's case, it was proved by repeated echocardiography with the application of dobutamine stress test, as well as ergometry. The most frequent causes of death in patients with implanted LVAD are as follows: haemorrhagical cerebrovascular insult; right ventricle failure; multi-organ failure; and ishemical cerebrovascular insult. Despite the extreme negative outcome, the treatment with the mechanical left heart support has contributed to the improvement of cardiac function and reduced the NYHA stage with improvement of the general condition, after which the patient was fully mobile and discharged from hospital.

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Sažetak

Rana klinička iskustva sa dugoročnom potporom (Thoratec)

Unatoč novijim dostignućima u liječenju kongestivnog zatajivanja srca, broj ljudi sa srčanim popuštanjem kontinuirano raste što dovodi do povećane stope mortaliteta i morbiditeta.

Transplantacija srca je često ograničena zbog nedostatka broja adekvatnih donora, a medikamentozna terapija ostaje palijativna. Korištenje mehaničke cirkulacijske potpore (LVAD-left ventricular assist device), kao standardne terapije u liječenju završne faze zatajivanja srca značajno je poboljšalo ishod liječenja.

Mehanička potpora lijevom ventriklu, prvotno primjenjena kao metoda privremenog premoštenja prema ozdravljenju (bridge-to-recovery), zatim kao premoštenja do transplantacije (bridge–to-transplantation), danas se primjenjuje kao trajna opcija liječenja bolesnika s terminalnom fazom srčanog zatajivanja.

U ovom radu prikazan je slučaj bolesnika s dilatativnom kardiomiopatijom, kojem je po prvi puta, u Republici Hrvatskoj, zbog zatajivanja srca ugrađena parakorporalna mehanička potpora lijevom srcu.

Ključne riječi: kongestivno zatajivanje srca; transplantacija srca; mehanička cirkulacijska potpora; mehanička potpora lijevom ventriklu