Left Ventricular Assist Device Followed by Heart Transplantation

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Introduction

Heart failure (HF) is the major cause of cardiovascular hospitalization in Brazil[1]. It is estimated that approximately 1%–2% of the population present with HF and 50% of these individuals have a decreased ejection fraction[2].

In the last 30 years, despite the substantial improvement in the treatment of chronic HF, the quality of life and survival rates of affected patients are limited. In addition, most of these patients are refractory to standard treatment and hospitalization, and rates of death or rehospitalization within 6 months are approximately 50%[2].

Heart transplantation (HT) is considered the standard treatment in patients with advanced or refractory HF. However, this procedure is limited by the number of available donors and possible contraindications, such as pulmonary hypertension (PH) secondary to HF[3].

Since 1994, after the approval of the use of implantable ventricular assist devices (VADs) for long-term therapy in patients with advanced HF in the United States, there has been an increased interest in these devices. Technological improvement of VADs has resulted in the improved survival and quality of life in patients undergoing implantation, and the limitations of HT render these devices as an important tool for the treatment of advanced HF[4,5].

In Brazil, VAD therapy for patients with HF is still nascent. Here we report, to the best of our knowledge, the first case of hospital discharge after VAD implantation and subsequent HT.

Case Report

A 41-year-old male patient presented with HF symptoms and was diagnosed with idiopathic dilated cardiomyopathy in 2008. Even after optimization of drug therapy, HF remained as New York Heart Association (NYHA) functional class II. The patient had no other comorbidities. In 2012, the patient experienced a progressive worsening of symptoms and signs of HF in spite of therapy with enalapril, carvedilol, spironolactone, ivabradine, digoxin, and furosemide.

Keywords

Heart Transplantation; Heart-Assist Devices; Heart Failure; Shock, Cardiogenic.

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After being hospitalized for cardiogenic shock, the patient was started on intravenous administration of inotropic and vasodilator agents. This resulted in the stabilization of hemodynamic parameters, but the patient remained dependent on inotropic support [Interagency Registry for Mechanically Circulatory Support (INTERMACS classification 3). The echocardiographic parameters at admission are detailed in Table 1. The evaluation for HT revealed the following findings: a significant HF with pulmonary artery pressure (PAP) of 96 × 33 (56) mmHg, transpulmonary gradient of 25 mmHg, and pulmonary vascular resistance of 6.5 Wood units, with little response to systemic and pulmonary vasodilators. Thus HT was contraindicated and the patient was then indicated for VAD therapy.

The patient had a few risk factors for right ventricular (RV) dysfunction, one of the major early complications of VAD implantation. The central venous pressure was 15 mmHg, with mild tricuspid insufficiency. Echocardiographic evaluation (Table 1) showed no significant RV dilation, and the main parameters used in the assessment of RV function [tricuspid annular plane systolic excursion (TAPSE), fractional area change, and S' wave] suggested a mild RV dysfunction.

In August 2012, the patient underwent implantation of continuous-flow VAD (Berlin Heart INCOR®). The flow was approximately 5 L/min and the hemodynamic management was initially performed with inotropic agents, vasopressors, nitric oxide, and diuretics/crystalloid for adjustment of blood volume. The patient's hemodynamic parameters were stable postoperatively. The anticoagulation regime administered to the patient involved unfractionated heparin and antiplatelet therapy and was initiated early on the first postoperative day.

During the postoperative period, serial computed tomography examinations revealed that the patient exhibited transient focal neurological deficit without evidence of structural changes. In addition, the patient presented with pneumonia associated with mechanical ventilation, need for prolonged intubation, and acute renal failure (ARF). Therefore, he was subjected to transient renal replacement therapy. These complications were fully reversed during recovery.

Subsequently, HF therapy with enalapril, beta-blockers, loop diuretics, spironolactone, and sildenafil was reintroduced. The patient was maintained on warfarin and antiplatelet therapy with acetylsalicylic acid (ASA) and clopidogrel, and was discharged 137 days after VAD implantation, without any functional dependence and in good clinical condition. Sequential echocardiographic evaluations after VAD implantation showed no worsening of RV function. In addition, we observed a significant decrease in the systolic PAP during recovery (Table 2), which eliminated the contraindication for HT. Eight months after VAD implantation, the patient expressed desire to be listed for HT.

Table 1 – Pre-VAD implantation echocardiogram results

				Evaluation of the right ventricle		Normal values
LA	50 mm	LVEF (Teicholz)	24%	Basal diameter	45 mm	< 45 mm
Septum	8 mm	FSLV	11%	Average diameter	31 mm	< 35 mm
PW	8 mm	Mass Index	128 g/m^2	Longitudinal diameter	72 mm	< 86 mm
LVDD	71 mm	Diastolic dysfunction	Gade 3	Sphericity index	0.625	< 0.6
LVSD	63 mm	MR	Important	Variation in the RV fractional area	26%	> 35%
LVDV	264 ml	TR	Mild	TAPSE (mm)	17 mm	> 16 mm
LVSV	201 ml	SPAP	72 mmHg	S wave (cm/s)	10 cm/s	> 10 cm/s

LA: left atrium; LVDD: left ventricular diastolic diameter; LVSD: left ventricular systolic diameter; FSLV: fractional shortening of the left ventricle; LVEF: left ventricular ejection fraction; MR: degree of mitral regurgitation; TR: degree of tricuspid regurgitation; PW: posterior wall; SPAP: estimated systolic pulmonary artery pressure; RV: right ventricle; LVDV: left ventricular diastolic volume; LVSV; left ventricular systolic volume; TAPSE: tricuspid annular plane systolic excursion

Table 2 – Evolution of pulmonary systolic pressure estimated by echocardiography

Time	Before implantation	30 days after implantation	90 days after implantation	120 days after implantation	280 days after implantation
SPAP (mmHg)	72	60	58	33	34

SPAP: systolic pulmonary artery pressure.

In the immunological evaluation of the patient, the immune panel (HLA I/II using the Luminex® method) changed from 0%/0% before VAD implantation to 0%/23% after implantation. After inclusion in the HT list, the patient developed signs of inflammation in the subxiphoid region. Because the VAD infection did not resolve with antibiotic therapy, the patient was prioritized for HT, to avoid VAD-associated complications. Approximately 14 months after implantation, the patient underwent HT successfully without acute rejection or graft dysfunction. However, he had infectious complications and reversible acute renal failure, and he was discharged 75 days after the procedure. At present, the patient is on outpatient care, with a good functional status.

Discussion

The INTERMACS database has reported the implantation of approximately 7,000 VADs worldwide since 2006; in addition, after 2010, the number of annual implants has increased 10 times in comparison with the first registration years[4,5]. To the best of our knowledge, this is the first report of a patient discharge in Brazil after VAD implantation and subsequent HT. The first case of mechanical circulatory support in Brazil was reported in 1994, when a patient with Chagas cardiomyopathy received a ventricular assist device as a bridge to transplant[6].

Indwelling devices are indicated for the following situations (i) long-term strategic planning for patients eligible for HT (bridge to transplantation), aiming at improving the functionality of VADs and the patient's quality of life, in comparison with those with a long waiting period in the transplantation list; (ii) in patients in whom HT benefits are uncertain or marginal (bridge to application); (iii) as definitive therapy for those who are not candidates or in case of HT unavailability[7].

The first indwelling devices introduced into clinical practice were pulsatile. The REMATCH Trial randomly selected 129 patients, with HF NYHA class IV and ineligible for HT, to receive the HeartMate XVE™ device or remain on standard drug therapy. The implantation of the device yielded a 48% decrease in the risk of death within 1 year after implantation[8]. The HeartMate II trial randomly selected 200 patients, with advanced HF and ineligible for HT, to receive continuous flow or pulsatile flow devices. The 2-year survival rates in the pulsatile and continuous flow groups were 24% and 58%, respectively[9].

At present, most VAD implants serve as a bridge to HT in patients with cardiogenic shock who require inotropic agents and in those who are either clinically stable (INTERMACS classification 3) or have progressive clinical worsening (INTERMACS classification 2). However, in recent years, we have observed a progressive increase in the number of implants in less-severe patients and as definitive therapy for those ineligible for HT[4].

The patient described in the present case report was initially considered as a candidate for VAD implantation because of PH and important contraindications to HT. However, after 120 days of implantation, there was a significant decrease in PAP values, which reached levels close to normal. This decrease in pulmonary pressures in patients who underwent VAD implantation has been previously described, and some authors advocate the use of VAD therapy to decrease the pulmonary pressure on potential HT candidates with PH[10].

Despite the immunological sensitization after VAD implantation, there were no acute rejections after HT. The transfusions of blood products after implantation may be related to the post-procedure sensitization; however, a

correlation between VAD implantation and alloimmunization may exist[11]. This case shows that VAD implantation is feasible in Brazilian patients with advanced HF who are contraindicated for HT. Initial PH did not affect implantation outcomes, and the subsequent normalization of PAP led to successful HT.

In Brazil, the number of VAD implants is substantially lower than that in the United States and Europe. Despite evidence of improved survival and quality of life in patients who underwent VAD implantation, the direct and indirect costs of this therapy are still high and the procedure is not free of complications. Therefore, an evaluation of cost-effectiveness is necessary for the careful selection of patients who would benefit from this therapy, considering the nascent use of VADs in Brazil.

Author contributions

Conception and design of the research: Biselli B, Ayub-Ferreira SM, Avila MS, Gaiotto FA, Jatene FB, Bocchi EA; Acquisition of data: Biselli B, Ayub-Ferreira SM, Avila MS, Gaiotto FA, Jatene FB, Bocchi EA; Analysis and interpretation of the data: Biselli B, Ayub-Ferreira SM, Avila MS, Gaiotto FA, Jatene FB, Bocchi EA; Writing of the manuscript: Biselli B, Ayub-Ferreira SM, Bocchi EA; Critical revision of the manuscript for intellectual content: Biselli B, Ayub-Ferreira SM, Avila MS, Gaiotto FA, Jatene FB, Bocchi EA.

Potential Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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