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Removal of left ventricular assist device: first case from Turkey

Sol ventrikül destek cihazının çıkarılması: Türkiye'den ilk olgu

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ABSTRACT

In recent years, due to the donor shortage for heart transplantation, the utilization of the left ventricular assist devices has been increasing in Turkey, as well as the worldwide. Herein, we report the first case from Turkey, a 12-year-old male case of left ventricular assist devices due to cardiomyopathy developing after monomorphic atrial tachycardia which was explanted after 109 days follow-up.

Keywords: Bridge to recovery; device removal; left ventricular assist device.

ÖZ

Son yıllarda bütün dünyada olduğu gibi, Türkiye'de de kalp nakli için donör azlığı nedeniyle, sol ventrikül destek cihazlarının kullanımı artmaktadır. Bu yazıda, Türkiye'den ilk olgu olarak monomorfik atriyal taşikardinin ardından gelişen kardiyomiyopati nedeniyle sol ventrikül destek cihazı takılan ve 109 günlük takipten sonra çıkarılan 12 yaşında bir erkek olgu sunuldu.

Anahtar sözcükler: İyileşmeye köprü; cihaz çıkarma; sol ventrikül destek cihazı.

Conventionally, ventricular assist devices have become standard therapy for patients with advanced heart failure either as a bridge to transplantation or destination therapy.[1] However, certain patients may develop myocardial recovery after a time of left ventricular assist device (LVAD) support. In these patients, LVAD explantation requires careful assessment of myocardial functions and explantation procedure without any complication.[2]

CASE REPORT

A 12-year-old boy applied to our emergency clinic with complaints of palpitation and fatigue. Electrocardiography showed monomorphic atrial tachycardia. His medical history revealed non-responsiveness to amiodarone and adenosine treatment for arrhythmia. Ejection fraction (EF) was 23%. The patient developed left heart failure at the radiofrequency catheter laboratory in the course of ablation and the procedure was, then, abandoned. He was taken to the intensive care unit and medical therapy was initiated for cardiac insufficiency and tachycardia.

In the following day, ejection fraction was 18% and the left ventricular systolic (LVESD) and diastolic (LVEDD) diameters were 57 mm and 63 mm, respectively. Peripheral venoarterial extracorporeal membrane oxygenator (ECMO) (Medos Medizintechnik AG, Stolberg, Germany) was applied by femoral artery and vein. After a well-being for five days for hemodynamic response to the all back-up, the patient needed to be supported with an LVAD. A written informed consent was obtained from the parents of the patient. The HeartWare Ventricular Assist Device (HVAD; HeartWare International, Ltd., Framingham, MA) was implanted through a midline sternotomy. Other short-term support systems did not preferred, as the duration of the use of them was thought to be limited and the patient needed to be confined to bed in case of the application of such systems.

In the second postoperative day, the patient was extubated and inotropic and antiarrhythmic agents were reduced. Intermittent atrial tachycardia attacks were attempted to be managed with metoprolol. Anticoagulation was managed with warfarin.

Following a month, second radiofrequency catheter ablation was successfully applied. After this intervention, recovery was accelerated and

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echocardiographic values improved within one week (LVESD: 43 mm, LVEDD: 61 mm, EF: 55%).

In the fourth month postoperatively, the patient was hospitalized due to a suspected driveline infection. Cultures around the driveline and surveillance were negative. In the meantime, echocardiography showed progression (LVESD: 34 mm, LVEDD: 50 mm, EF: 57%).

Cardiac hemodynamic study was performed, while percutaneous balloon occlusion of the outflow graft at the aortic anastomosis site, and LVAD was brought to a stand to inspect the capability of the heart (Table 1). Cardiac index calculated 2.26 lt/min/m^2 and LVAD explantation decision was taken based on these values.

The explantation procedure was performed after 109 days on the LVAD. A written informed consent was obtained from the parents of the patient. The patient was placed in a lateral recumbent position using a left hip roll; therefore, the incision was made with a left anterolateral submammary thoracotomy in the sixth intercostal space. The Right femoral vein and artery were kept ready for emergency cannulation. The pump and driveline were accessed. The outflow graft was dislodged from the seventh intercostal space. The sewing ring was laid bare to gain access to the pan head screw. After heparin administration (5,000 IU), the outflow graft was clamped, ligated, and, then, transected approximately 2 cm from the pump. The sewing ring screw of the LVAD was opened, the pump was removed, and the apical cannulation site was occluded with a specifically manufactured titanium plug (Fittkau Metallbau GmbH, Berlin, Germany) inserted instead of the inflow cannula; the ring screw was, then, closed (Figures 1, 2). Next, the driveline was divided and, finally, the driveline was accessed by a small abdominal incision and withdrawn through the percutaneous driveline exit site. The patient was transferred to the ward from the intensive care unit two days later and was discharged from the hospital in the eighth postoperative day. Currently, he is at home without any arrhythmia and signs of heart failure.

DISCUSSION

In March 1995, at the German Heart Institute Berlin, a patient supported with a LVAD for 160 days showed significant improvement in cardiac function and the LVAD was explanted. This was the first case of its kind worldwide. In recent years, the number of reports of weaning from LVAD support after cardiac recovery has increased.[3]

In Turkey there are 539 intracorporeal LVAD were used for 491 heart failure patient so far, and our case was the first explantation after recovery.

The access midline sternotomy is the first method used for the explantation of intracorporeal LVADs.[4] Although full sternotomy LVAD explantation is shown to be feasible, it may be associated with an increased risk for intraoperative bleeding, need for blood transfusions, and postoperative ventricular dysfunction.[5] Cheung et al.[6] described a successful subxiphoidal explantation procedure for a HeartMate II, whereas Schweiger et al.[5] showed the left lateral thoracotomy without the need for cardiopulmonary bypass (CPB) explantation of the HeartWare LVAD and closure of the apical cannulation site with a titanium plug.

Figure 1. After the dissection, device was exposed at the apex of the heart.

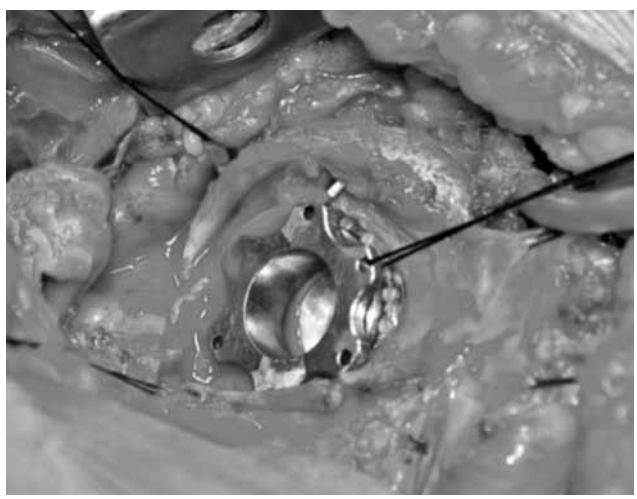

Figure 2. After the removal of the device the titanium plug was positioned to occlude the apical cannulation site.

Table 1. Hemodynamic variables on percutaneous balloon occlusion of the outflow graft and left ventricular assist device

	Full pump support	Reduced pump speed	Off pump graft not occluded	Off pump graft occluded
Pump speed (rpm)	2320	1800		
Pump flow (lt/min)	2.7	1.6		
Pulmonary artery pressure (mmHg)				
Systolic	29	37	10	29
Diastolic	13	11	6	17
Mean	18	20	7	18
Pulmonary capillary wedge pressure (mmHg)	12	9		10
Left ventricle end diastolic pressure (mmHg)	52	52	51.5	46.7
Central venous pressure (mmHg)	7	9		6
Arterial blood pressure (mmHg)				
Systolic	104	107	117	103
Diastolic	74	60	56	64
Mean	84	76	65	74
Ejection fracture (%)	62	62	62	55
Heart rate (bpm)	80	108	115	116
Left ventricle end systolic pressure (mmHg)	35	34	34	33
Mitral regurgitation	2/4	2/4	2/4	2/4
Right ventricular pressure (mmHg)	34/0/8	40/0/8		36/7/10

In our case, we prefer the Schweiger's left lateral thoracotomy without CPB. However, differently, we used seventh intercostal space approach additional to sixth to reach and remove the outflow graft totally to eliminate the disadvantages of the remainder of the outflow graft *in situ* along with a possible risk for late infection.

Using the titanium plug by keeping the sewing ring of the LVAD may reduce the risk of perioperative bleeding and infections. Shortening the operating time due to no need for explantation of the ring and closing the left ventricle and preserving the geometry of the left ventricle are advantages of using this special plug.

In conclusion, left ventricular assist device is a conventional method for treatment of advanced heart failure. If the recovery could be managed, removal of the device should be considered. Left lateral thoracotomy approach and the use of the special plug for closing of the apical cannulation site are the emphases of the procedure.

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