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Continuous flow ventricular assist device implantation in pediatrics: Single center experience

Pediyatrik vakalarda sürekli akım sağlayan ventrikül destek cihazi implantasyonu: Tek merkez deneyimi

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Abstract

Aim: Heart transplantation is the gold standard of treatment for patients with medical therapy resistant end-stage heart failure. Particularly in the pediatric age group use of ventricular asist device (VAD) is mandatory, due to donor organ limitation and prolonged waiting lists.

Materials and Methods: This retrospective review of fourteen patients under 19 years of age who underwent continuous flow left VAD implantation between August 2012 and March 2018. All patients have met the criteria for heart transplantation. HeartWare (HeartWare Inc. Medtronic) HVAD was implanted to all patients.

Results: There were eight girls and six boys with a mean overall age of 15.4 (minimum11-maximum 18) years and mean body weight of 42.4 kg and body surface area (BSA) is 1.4 kg/cm². The mean follow-up was 549 days. Survival rate at six months was 90%. Six patients (42.9%) are still waiting for transplantation on VAD support. Six patients (42.9%) underwent heart transplantation successfully. Two patients died while they were waiting for transplantation on device support.

Conclusion: The use of continuous flow ventricular assist devices became more popular because reduced dimensions along with technological advances. In this article, we wanted to share our experience about continuous flow ventricular assist device implantation as bridge to transplantation in pediatric patients.

Keywords: Pediatric, heart failure, ventricular assist device.

Öz

Amaç: *Kalp transplantasyonu medikal tedaviye dirençli hastalarda altın standart tedavi yöntemidir. Tüm dünyada olduğu gibi ülkemizde de özellikle pediatrik yaş grubunda donör organ kısıtlılığı ve uzayan bekleme listeleri ventrikül destek sistemlerinin kullanımını zorunlu kılmıştır.*

Gereç ve Yöntem: *Bu çalışmada, kliniğimizde Ağustos 2012 ile Mart 2108 tarihleri arasında 19 yaş altı olgularda devamlı akım sağlayan ventriküler destek cihazı implante edilmiş olgular retrospektif olarak değerlendirildi. Hastaların tümü kalp nakli kriterlerine uygundu. Tüm hastalara HeartWare (HeartWare inc. Medtronic) HVAD cihazı implante edildi.*

Bulgular: *Yaş ortalaması 15,4 (minimum11-maksimum 18) olan 8 kız, 6 erkek olgunun, ortalama kilosu 42,4 kg, vücut yüzey alanı ise 1,4 kg/cm², ortalama takip süresi 549 gün, 6 aylık survi %90 olarak değerlendirildi. Altı (%42,9) olgu halen destek altında takibimizde iken, 6 olguya başarılı şekilde kalp transplantasyonu yapıldı. Destek altında iken 2 olgu kaybedildi.*

Sonuç: *Teknolojik ilerlemeler ile büyük ve pulsatil akım sağlayan pompalardan sonra son yıllarda boyutları oldukça küçülen sürekli akım sağlayan ventrikül destek sistemlerinin kullanımı yaygınlık kazanmıştır. Bu yazımızda kliniğimizde pediatrik yaş grubunda nakile köprü amaçlı sürekli akım sağlayan ventrikül destek cihazı implantasyonu deneyimlerimiz paylaşılacaktır.*

Anahtar Sözcükler: *Pediatrik, kalp yetmezliği, ventriküler destek cihazı.*

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Introduction

Heart failure represents an important cause of morbidity and mortality in pediatric patients. Hospitalization incidence of pediatric patients with end-stage heart failure has been on rise in recent years. Heart transplantation has a higher prominence in end-stage heart failure in children (1). Some of patients require mechanical circulatory support due to donor organ shortage especially as a result of rarity of small donor hearts (2). Surgical alternatives such as ventricular assist device (VAD) have enabled recovery of the myocardium and ensure patient survival until heart transplantation becomes possible. Here in we reviewed our experience of continuous flow VAD implantations for bridge to transplantation (BTT) in pediatric population (≤18 years old) with end-stage heart failure.

Materials and Methods

This retrospective review of fourteen patients under 19 years of age who underwent continuous flow left VAD implantation between August 2012 and March 2018. All patients have met the criteria for heart transplantation. HeartWare (HeartWare inc. Medtronic) HVAD was implanted to all patients. Left VAD implantations were performed through a median sternotomy, with cardiopulmonary bypass, through cannulation of ascending aorta and right atrium on beating heart without cardioplegic arrest. Inflow cannulation was inserted through the left ventricular apex. The outflow cannula was sutured to the proximal ascending aorta with the assistance of a side-biting clamp.

Intravenous heparin application to maintain the activated partial thromboplastin time between 50-70 seconds was administered after 24-48 hours according to chest tube drainage. After chest drain removal and tolerance of oral medication 100 mg of aspirin and warfarin administered to maintain a target international normalized ratio (INR) between 2 and 3. Prolonged intubation was defined as intubation time longer than 48 hours. Statistical evaluation of the study program SPSS v20 (IBM Inc.) for descriptive statistical tests.

Results

Demographic data and results of patients are summarized in Table-1.

Table-1. Clinical Characteristics of the Patients.

Gender	Male	6 (42.9%)			
	Female	8 (57.1%)			
		Min	Max	Mean	Std. Dev.
Age		11.00	18.00	15.42	2.37
Weight		20.00	78.00	47.42	16.90
BSA		.80	1.90	1.45	.33
CPB time		39.00	90.00	60.35	12.24
Ejection Fraction		15.00	35.00	21.28	5.64
Follow-up time		15.00	2022.00	549.35	524.13
Result	Follow-up	6(42.9%)			
	Transpl.	6(42.9%)			
	Exitus	2(14.3%)			
INTERMACS Score	1	1(7.1%)			
	2	9(64.3%)			
	3	4(28.6)			

BSA: Body Surface Area, INTERMACS: Interagency registry for mechanically assisted circulatory support, CPB: Cardiopulmonary bypass, Transpl.: Transplantation.

There were eight girls and six boys with a mean overall age of 15.4 (minimum11-maximum 18) years and mean body weight of 42.4 kg and body surface area (BSA) is 1.4 kg/cm². The mean follow-up was 549 days. Mean left ventricular ejection fraction (LVEF) was 21.2%. Interagency Registry for Mechanically Assisted Circulatory Support (INTERMACS) profile of patients at the time of implantation was 1 in one (7.1%) patient, 2 in nine (64.3%) patients and 3 in four (28.6%) patients. Dilated cardiomyopathy was the etiology of heart failure in all patients.

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Survival rate at six months was 90%. Temporary right ventricular support was required in only one patient after LVAD implantation. The Levitronix CentriMag device was used for four days then device was removed. Six patients (42.9%) are still waiting for transplantation on VAD support. Six patients (42.9%) underwent heart transplantation successfully. Two patients died while they were waiting for transplantation on device support. Hemorrhagic cerebrovascular event was the cause of death in both patients. One of them underwent device exchange with a left anterior thoracotomy due to device thrombosis after two years of first implantation.

There were no other common adverse events such as gastrointestinal bleeding or driveline infection and renal replacement therapy was not required for any patients.

Discussion

Heart transplantation is still the gold standard treatment for patients suffering from end-stage heart failure. The number of patients on the waiting list for heart transplantation increases day by day due to donor organ shortage especially suitable size of organ for pediatric patients. Last decade has witnessed a remarkable progress in mechanical circulatory support systems for

pediatric patients with end-stage heart failure, resulting in improved functional capacity, quality of life and survival in this population (3). Usage of continuous flow ventricular asist devices for BTT is increasing every year the rate was 21% in 2005 and 27% in 2015 (4).

Six months survival is approximately 72% in pediatric VAD patients. Neurological events and multi-organ failure is the most frequent cause of mortality which is similar with our study. Major adverse events during VAD support are infection, bleeding, and neurologic events including stroke, subarachnoid hemorrhage. Dilated cardiomyopathy is the most common cause of heart failure and most of the patients were in INTERMACS profile 2. These findings are also similar with our study (5).

Conclusion

In conclusion, VAD can be successfully applied in the pediatric age group as well as in adult patients for bridge to transplant due to the shortage of donor organs. With this technique, we reduced the hospitalization rates and improved the quality of life of the children outside the hospital.

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