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# Minimally invasive implantation of left ventricular assist device HeartWare HVAD

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ABSTRACT

*Introduction:* Long-term left ventricular assist devices are nowadays part of standard therapy for patients in terminal phase of heart failure. Lower invasiveness of implantation might have the potential to enhance results of these high risk patients. The aim of this study is to introduce our minimally invasive approach to the implantation of left ventricular assist device of the latest generation HeartWare ventricle assist device (HVAD) and our initial experience with this method.

*Methods:* In our department we implanted HVAD between November 2013 and November 2014 in 8 patients as a bridge to heart transplantation. All patients were male with average age 59.5 ± 6.4 years. Basic diseases were dilated cardiomyopathy in 6 patients (75%), ischemic cardiomyopathy in 2 patients (25%). The mean value of left ventricular ejection fraction was 10 ± 3.6%, right ventricular ejection fraction was 35 ± 5.6%. Access to the left ventricular apex was reached by left-sided thoracotomy of approximately 8 cm. To access the ascending aorta we used upper J ministernotomy.

*Results:* Minimally invasive implantation was successfully done in all patients. In one patient closure of foramen ovale was simultaneously performed. Most patients (75%) were extubated on the first postoperative day. In one case, a failure of the right ventricle occurred with the need for temporary right-sided circulatory support device Centrimag. No patient died, four patients have successfully undergone heart transplantation, other are followed on an outpatient basis.

*Conclusion:* Minimally invasive implantation of left ventricular assist device HeartWare HVAD is safely feasible. After a very good initial experience with this technique it has become the method of choice in our department.



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## Introduction

Implantation of left ventricular assist device (LVAD) as a bridge to heart transplantation nowadays represents part of standard therapy for the group of critically ill patients in the Czech Republic [1,2]. Guidelines of European Society of Cardiology recommend LVAD implantation in patients awaiting heart transplantation to improve their symptoms and to prevent readmission due to worsened heart failure (Class I/B recommendation) [3].

Standard medial sternotomy is the most frequent approach for LVAD implantation worldwide. Substitution of full sternotomy with smaller incisions may lead to the same effects as other minimally invasive cardiac surgery, i.e. to reduce blood loss, number of blood transfusions, infections, time of mechanical ventilation, length of ICU stay and total time of hospitalization [4,5]. These approaches are particularly beneficial for polymorbid and elderly patients [6]. A further positive factor of great significance is that the minimally invasive approach does not disrupt the integrity of pericardium, and thus we can avoid the negative impact of pericardium opening on the function of the right ventricle [7–9]. This approach left the sternum largely intact and outflow graft of LVAD is covered by pericardium, which considerably simplifies subsequent heart transplantation.

HeartWare VAD (HVAD) represents the latest LVAD generation of substantially smaller dimensions comparing to preceding systems, which enables completely intrapericardial implantation (see Fig. 1).

To perform minimally invasive HVAD implantation we apply incisions which have been commonly used in our department to perform other operations. Thus, we managed to eliminate the potential effect of learning curves. We use left-sided minithoracotomy to perform transapical transcatheter aortic valve implantation. The upper partial J ministernotomy is used for minimally invasive aortic valve replacement.

**Fig. 1 – Miniaturized centrifugal pump HeartWare with integrated inflow cannula.**

## Material and methods

### *Group of patients*

In our department, the implantation of mechanical circulatory support has been carried out since 2009; we have performed 57 operations in total. Since February 2013, we have implanted HVAD as a bridge to heart transplantation in 11 patients in total, 8 of whom, who are the subject to this study, underwent the minimally invasive approach. All patients were male, the median age of the patients was 59.5 ± 6.4 years. Six patients suffered from dilated cardiomyopathy (75%), ischemic cardiomyopathy was the primary disease in 2 patients (25%). The mean left ventricular ejection fraction was 10 ± 3.6%, right ventricular ejection fraction was 35 ± 5.6%, diastolic diameter of the right ventricle (RV) was 42 ± 5.2 mm. TAPSE (tricuspid annular plane systolic excursion) was 17 ± 3.5 mm. Other diseases included diabetes in 4 patients (50%), chronic obstructive pulmonary disease in 4 patients (50%), chronic renal insufficiency in 2 patients (25%), hepatopathy in 3 patients (37.5%).

### *HeartWare HVAD*

The system of implantable left ventricular assist device HVAD consists of a miniaturized centrifugal pump with integrated inflow cannula and outflow graft, external control unit and an external source of energy (2 batteries, power supply) (see Fig. 2). The pump is attached to the left ventricular apex

**Fig. 2 – HeartWare HVAD.**