Left Ventricular Assist Device Implantation in Patients With Optimal and Borderline Echocardiographic Assessment of Right Ventricle Function

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ABSTRACT

Background. Left ventricular assist devices (LVADs) are used for treatment of end-stage heart failure. Outcomes are dependent on right ventricle (RV) function. Prediction of RV function after LVAD implantation is crucial for device selection and patient outcome.
The aim of our study was to compare early LVAD course in patients with optimal and borderline echocardiographic parameters of RV function.

Material and methods. We retrospectively reviewed 24 male patients with LVAD implantation. The following echocardiographic data of RV function were collected: FAC (fractional area change) with optimal value $>20\%$, tricuspid annulus plane systolic excursion >15 mm, RV diameter <50mm, and right-to-left ventricle ratio <0.57 (RV/LV). Patients were divided into group 1 (12 patients) with transthoracic echocardiography parameters in optimal ranges and group 2 (12 patients) with suboptimal transthoracic echocardiography findings. Study endpoints were mortality, discharge from the intensive care unit, and RV dysfunction. Demographics, postoperative clinical outcomes, comorbidities, complications, and results in a 30-day period were analyzed between groups.

Results. Echocardiography parameters differed significantly between groups 1 and 2 according to FAC (31.8% vs 24.08%; $P = .005$), RV4 (45.08 mm vs 51.69 mm; $P = .02$), and RV/LV ratio (0.6 vs 0.7; $P = .009$).
Patients did not differ according to course of disease, comorbidities before implantation, or complications. One patient from each group died. Patients in group 2 experienced more pulmonary hypertension, required increased doses of catecholamines, and stayed in the intensive care unit longer. No RV dysfunction was noted.

Conclusions. Borderline FAC, tricuspid annulus plane systolic excursion, and RV4 add RV/LV ratio prolonged recovery after LVAD implantation even with no RV failure. Parameters chosen for qualification are in safe ranges.

THE number of patients diagnosed as having end-stage heart failure is increasing [1]. Implantation of left ventricular assist devices (LVAD) is one method of heart failure therapy approved by the Food and Drug Administration and the community. Main indications for LVAD implantation are bridge to recovery, bridge to transplantation or destination therapy, potentially reversible

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secondary organ failure, and pulmonary artery hypertension [2]. The use of LVAD showed reduction in mortality in patients awaiting heart transplantation; the Randomized Evaluation of Mechanical Assistance for the Treatment of Congestive Heart Failure trial showed improved survival and quality of life in patients diagnosed as having end-stage heart failure but who were not eligible for cardiac transplantation [3–5]. LVAD function relies heavily on right ventricular (RV) function for adequate preload. Severe right ventricular failure (RVF) can lead not only to systemic hypoperfusion, multiorgan failure, and death, but also to prolonged or recurrent hospitalization and poor quality of life even in less extreme cases [6–11]. Improved outcomes and lower rates of RVF result from the use of continuous-flow LVADs compared with the use of pulsatile-flow devices [3]. Despite development of clinical prediction scores to facilitate preoperative identification of patients at risk for RVF after implantation [12–15], RVF still occurs in 13% to 40% of continuous-flow device recipients [16]. Therefore, preoperative prediction of RV function after LVAD implantation is important for device selection and patient outcome. The present study shows a relationship between preoperative echocardiography findings of RV function and outcome in perioperative period after LVAD implantation. We compare outcome of 2 groups of patients with differences in RV function evaluation in echocardiographic parameters. We assessed tricuspid annular plane systolic excursion (TAPSE), fractional area change (FAC), right-to-left ventricle ratio (RV/LV) ratio, and RV in 4-chamber view (RV4). The aim of our study was to assess outcome of patients diagnosed as having end-stage heart failure after LVAD implantation according to RV function in preoperative echocardiographic measurements.

MATERIALS AND METHODS

All 25 (25 male) consecutive patients with LVAD implantation at Silesian Centre for Heart Diseases between January 1, 2013, and October 28, 2014, were retrospectively analyzed. One patient was excluded because of lack of echocardiography measurements in our database. Demographic data and comorbidities are summarized in Table 1. Patients had implanted continuous-flow devices (18 with HeartWare and 6 with HeartMate II). The reason for heart failure was ischemic cardiomyopathy in 8 patients and nonischemic cardiomyopathy in 16 patients. The institutional research ethics board reviewed and approved the study. Individual consent was obtained. Relevant echocardiographic baseline and postoperative outcome data were collected. We analyzed mortality as well as serious complications, such as neurologic, gastrointestinal, and renal failure. Study endpoints were mortality, discharge from the intensive care unit, and discharge home. All preoperative transthoracic echocardiography data used in the study were obtained between 24 and 48 hours before surgery. Transthoracic echocardiography (TTE) was performed according to the guidelines of the American Society of Echocardiography [17] using Philips ultrasound machines. TTE parameters confirmed RV function as FAC with value $>20\%$ (mean, 27.8%; range, 18%-44%) with 1 patient $<20\%$, TAPSE $>$ 15 mm (mean, 15.8 mm; range, 10–23 mm), RV diameter <50 mm (mean, 48.4 mm; range, 34–60.5 mm), and RV/LV ratio in 4-chamber view <0.75 (mean, 0.65; range, 0.5–0.81). Patients were divided into 2 groups according to these measurements. Group 1 consisted of 12 male patients with optimal parameters of RV function in TTE echocardiography measurements. Group 2 consisted of 12 male patients with borderline echocardiography findings. Values of TTE measurements are summarized in Table 2.

Table 1. Demographic Data

Parameters	Group 1		Group 2		*P* U M-W
	n	Average	n	Average	
Age (years)	12	53.29 ± 11.33	12	45.90 ± 11.39	**.03**
Weight (kg)	12	79.58 ± 9.90	12	77.33 ± 28.83	.18
Height (cm)	12	174.75 ± 6.90	12	177.50 ± 9.08	.62
BMI	12	26.16 ± 3.74	12	24.50 ± 8.26	.21
INTERMACS 2	12	7	12	7	.87
INTERMACS 3	12	3	12	0	.19
INTERMACS 4	12	2	12	4	.47
INTERMACS 5	12	0	12	1	.97
Unstable course of disease	12	8	12	10	.91
Ischaemic cardiomyopathy	12	5	12	3	.87
Diabetes mellitus	12	6	12	3	.31
Hypercholesterolemia	12	8	12	3	.06
Hypertension	12	4	12	3	.89
Obesity	12	3	12	3	.73
Renal insufficiency	12	6	12	6	.84
Stroke	12	1	12	2	.94
Peripheral vascular disease	12	0	12	2	.499
IABP	12	3	12	0	.19
HM II	12	2	12	4	.47

Data are presented as mean ± SDs or number of cases and fraction.

Abbreviations: BMI, body mass index; HM II, HeartMate II; IABP, intra-aortic balloon pumping; INTERMACS, Interagency Registry for Mechanically Assisted Circulatory Support.