Journal of Cardiac Failure Vol. ■■ No. ■■ 2016

Clinical Investigation

Ventricular Assist Device Therapy in Older Patients With Heart Failure: Characteristics and Outcomes

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ABSTRACT

Background: Limited data exist on outcomes in patients ≥70 years of age supported with the use of continuous-flow left ventricular assist devices (LVADs).

Methods: Data on 1149 continuous-flow LVAD recipients was queried from the Mechanical Circulatory Support Research Network. Groups were assigned based on age: ≥70 years ("older patients") and <70 years. The primary outcome was survival at one-year based on age grouping.

Results: Compared with younger patients (54.3 ± 11.2 y; n = 986), older patients (73.4 ± 3.0 y) constituted only 14% of LVAD implants. Older patients had similar rates of device thrombosis ($P = .47$) and stroke ($P = .44$), but survival-free of gastrointestinal bleeding (GIB) at 1 year was lower compared with younger patients (58% vs 69%; $P < .01$). Unadjusted survival at 1 year in older patients was 75% compared with 84% in younger patients, and at 2 years 65% versus 73% ($P = .18$). Age ≥70 years was not associated with increased mortality (adjusted hazard ratio [aHR] 0.94, 95% confidence interval [CI] 0.70–1.26; $P = .67$). Preoperative creatinine (aHR 1.57, 95% CI: 1.30–1.89, $P < .0001$), bilirubin (aHR 1.22, 95% CI 1.05–1.42; $P = .010$), and ischemic cardiomyopathy (aHR 1.43, 95% CI 1.11–1.84; $P = .005$) portended increased risk of death. In older patients, the only predictor of mortality was creatinine (HR 2.1, 95% CI 1.2–3.4; $P = .007$). Creatinine ≥1.4 mg/dL was associated with a 1-year survival of 65%, compared with 84% when the creatinine was <1.4 mg/dL ($P = .009$).

Conclusion: Age >70 years is an important consideration when assessing LVAD risk, but other correlates may be more predictive of LVAD survival. Older patients without renal dysfunction have survival similar to younger patients. Older patients should be counseled about age-correlated risks, including higher rates of GIB. (*J Cardiac Fail 2016;*■■*:*■■–■■)

Key Words: Geriatrics, Heart failure, Left ventricular assist device, Mechanical circulatory support.

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Manuscript received July 31, 2016; revised manuscript received October 6, 2016; revised manuscript accepted October 14, 2016.

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1071-9164/$ - see front matter

http://dx.doi.org/10.1016/j.cardfail.2016.10.004

Heart failure (HF) is a rapidly growing global epidemic affecting an estimated 37.7 million people worldwide.[1] Incidence and prevalence of HF increases with age. In men, each 10-year age increase from 65 to 85 years doubles the incidence rate, whereas in women the incidence rate triples from ages 65 to 74 and from 75 to 84 years.[2] Although heart transplantation remains the criterion standard therapy for advanced HF, age >70 years remains a relative contraindicationto transplant at most US centers.[3] A recent analysis from the United Network for Organ Sharing revealed that only 1.4% of adults receiving a cardiac transplant were over the age of 70 years.[4] Advanced age has been associated with increased morbidity and mortality in cardiac surgery and remains a strong

predictor of mortality as assessed by various surgical risk calculators.[5,6] Moreover, the older population is more likely to have medical comorbidities that preclude them from consideration for transplantation, such as chronic kidney disease and preexisting neoplasm.[3]

Left ventricular assist device (LVAD) as destination therapy (DT) for older patients with HF is of growing interest as this population of patients with advanced HF continues to grow. Evidence addressing outcomes after LVAD in this patient population is a challenge owing to varying definitions of "elderly" or "older" used in the literature.[7] Within the Interagency Registry for Mechanically Assisted Circulatory Support (INTERMACS), age has consistently been shown to be a risk factor for mortality after LVAD implantation.[8] With the Heartmate II risk score, each decade of age portended an increased risk of death at 90 days (odds ratio [OR] 1.45, 95% confidence interval [CI] 1.17–1.80; $P < .001$).[9] The age threshold for which the risk of an LVAD becomes unacceptable is undefined. Furthermore, the risk factors for mortality after LVAD implantation specifically in the elderly are unknown.

To help elucidate the effect of advanced age on outcomes in LVAD recipients, we performed an analysis of the Mechanical Circulatory Support Research Network (MCSRN) registry. Our goals were to describe the characteristics of older patients undergoing LVAD implantation, determine the impact of age on mortality, device complications such as stroke (ischemic and hemorrhagic), gastrointestinal bleeding (GIB), and pump thrombosis, and to identify potential predictors of mortality after durable LVAD implantation in older patients.

Patients and Methods

Five LVAD centers compose the MCSRN: University of Michigan, Inova Heart and Vascular Institute, Mayo Clinic, Vanderbilt University, and St Vincent Heart Center of Indiana. Each center has individual Institutional Review Board protocols in place that permit prospective data collection of durable LVAD recipients. The protocols comply with ethical guidelines outlined in the 1975 Declaration of Helsinki and the Health Insurance Portability and Accountability Act. Data are shared through a data use agreement and collected for analysis at a central data coordinating center managed through Vanderbilt University.

Data on 1149 continuous-flow LVAD recipients from May 2004 to May 2015 from the MCSRN were used for this retrospective analysis. Patients treated with the use of pulsatile-flow LVADs and biventricular assist devices were excluded. Patients were categorized based on age ≥70 years ("older age") and <70 years. Baseline demographics, laboratory values, implant characteristics, and follow-up events for LVAD recipients were obtained from the registry.

Definition of Post-LVAD Outcomes

The effect of age on post–durable LVAD implantation operative and long-term mortality was assessed. Operative mortality was defined as death during the index hospitalization or within 30 days of durable LVAD implantation. Adverse events related to durable LVAD implantation, such as GIB, stroke, infections, and suspected or confirmed device thrombosis, were classified according to the INTERMACS definitions.[10]

Statistical Analysis

Baseline data are presented as mean ± SD for continuous variables. Mean values were compared by means of the independent-samples *t* test. For categoric values, numbers and proportions are presented. Proportions were compared by means of Fisher exact test or Pearson test for $>2 \times 2$ comparisons. Kaplan-Meier methods were used to generate 1-year event-free survival curves, censoring patients at the time of transplantation or explantation for recovery. Log rank testing was used for curve comparison.

Multivariable modeling was prespecified to include the following pre-implantation parameters: age ≥70 or <70 years, sex, cardiomyopathy type, body mass index (BMI), INTERMACS profile, diabetes, hypertension, earlier sternotomy, device type, international normalized ratio (INR), bilirubin, and creatinine. Significant variables in a univariable analysis ($P < .10$) were included into the final multivariable model. Hazard ratios (HRs) with 95% CIs are provided. A 2-sided P value of <.05 was considered to represent statistical significance. All data were analyzed with the use of SPSS 22.0 (2011; IBM Corp, Armonk, New York).

Results

LVAD Utilization in Older Patients and Patient Demographics

From the MCSRN registry, data on 1149 continuous-flow LVAD recipients from May 2004 to May 2015 were analyzed according to groups assigned based on age ≥70 years (mean age 73.4 ± 3.0 y; n = 163) and <70 years (mean age 54.3 ± 11.2 y; n = 986). The age distribution of the entire cohort is presented in Fig. 1.

During the study period from 2004 to 2015, the first LVAD patient ≥70 years was implanted in 2006. The proportion of older patients implanted was low overall, peaking at 19% in 2011 and returning to 12% in 2014 despite a continued growth of all patients receiving LVAD therapy (Fig. 2).

Patients over the age of 70 years were more likely to be male (91%), have an ischemic cardiomyopathy (70%), atrial fibrillation (41%), hypertension (61%), diabetes (38%), and earlier sternotomy (45%; Table 1). Older patients also had a lower BMI (26.7 ± 4.5 vs 29.9 ± 16.1 kg/m^2; $P = .013$). Very few older patients (6%) were implanted as bridge to transplant (BTT) compared with 60% in those <70 years old ($P < .001$). Use of preoperative inotropes (72% vs 78%; $P = .262$) and intra-aortic balloon pumps (33% vs 40%; $P = .151$) did not differ between the 2 groups, but no older patients with HF were at INTERMACS profile 1 at the time of implantation.

Older patients had a lower glomerular filtration rate (49.6 ± 19.5 vs 55.4 ± 18.5 mL • min^{-1} • 1.73 m^{-2}; $P = .017$),