

# Substance abuse at the time of left ventricular assist device implantation is associated with increased mortality



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## KEYWORDS:

substance abuse;  
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heart failure;  
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**BACKGROUND:** Advanced heart failure teams are often faced with the decision of whether or not to offer a left ventricular assist device (LVAD) to patients who have end-stage heart failure and recent or ongoing substance abuse. The outcomes of these patients after LVAD implantation are unknown.

**METHODS:** Baseline predictors and outcomes were collected and analyzed from patients with active substance abuse and a cohort of patients without active substance abuse matched for age, INTERMACS profile and year of implantation. The primary outcome was all-cause mortality. Secondary outcomes included rates of listing for cardiac transplantation, transplantation and chronic drive-line infection.

**RESULTS:** The cohort consisted of 20 consecutive LVAD recipients with active substance abuse and 40 recipients without active substance abuse. During a median follow-up period of 2.3 years (IQR 1.4 to 3.6), the substance abuse group had 3.2 times the rate (hazard) of death compared with a matched cohort (HR 3.2, 95% CI 1.2 to 8.0,  $p < 0.05$ ). Furthermore, the rate of listing for transplant was 69% lower (rate ratio 0.31,  $p < 0.0005$ ), rate of cardiac transplant was 89% lower (rate ratio 0.11,  $p < 0.0005$ ), and risk of chronic drive-line infection was 5.4 times higher (rate ratio 5.4,  $p < 0.0005$ ) in the substance abuse group.

**CONCLUSIONS:** Active substance abuse in patients who received an LVAD was associated with increased mortality and overall poor outcomes. Larger scale data will be needed to confirm these findings and to inform decision-making in this population.

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Advanced heart failure teams are often faced with the decision of whether or not to offer a left ventricular assist device (LVAD) to patients who have end-stage heart failure

but ongoing substance abuse. Although LVADs can extend survival in end-stage heart failure,<sup>1–3</sup> active substance abusers were not included in the original LVAD trials and the outcomes of this population are unknown. Recently published guidelines on LVAD patient selection indicate that ongoing substance abuse is a relative contraindication to mechanical support, with the decision left to individual programs regarding periods of abstinence required before

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being considered for advanced therapies.<sup>4</sup> No published data exist to guide these recommendations. Data are now emerging about the impact of psychosocial factors on outcomes in LVAD recipients, with results mirroring those from solid-organ transplantation where poor support has been associated with worse outcomes.<sup>5-8</sup> Former substance abuse in cardiac transplant patients has been associated with higher rates of non-compliance and deaths related to non-compliance. No difference has been detected in overall survival in these small studies.<sup>6,9,10</sup>

LVADs present an opportunity to potentially extend life without using an organ for patients who would not otherwise live long enough to undergo substance abuse treatment. The ethics of whether or not to offer mechanical support to patients with an index hospitalization for cardiogenic shock and untreated substance abuse are complex.<sup>11</sup> In this study we report the outcomes of patients with active substance abuse who underwent LVAD placement. We hypothesized that the substance abuse group would have higher mortality compared with the general LVAD population.

## Methods

The internal review board of the University of Minnesota approved this study. A matched-cohort design was used.

### Active substance abuse patients

Electronic medical records were queried for substance abuse and LVAD-related codes from the *International Classification of Diseases, ninth revision* (ICD-9). The resulting records were then screened by members of the research team to find patients who met the following criteria:

1. Age > 16 years at the time of LVAD implantation.
2. LVAD placement with a contemporary continuous-flow device: HeartMate II (Thoratec, Pleasanton, CA) or HVAD (HeartWare, Framingham, MA).
3. History of substance abuse according to the criteria of the *Diagnostic and Statistical Manual of Mental Disorders, fourth edition* (DSM-IV), with one or more of one of the following substances: alcohol; methamphetamine; crack; cocaine; and heroin/chronic narcotics.
4. Ongoing use in the 6 months prior to LVAD of the original drug of abuse or any other illegal drug use.

### DSM-IV criteria for substance abuse

A pattern of substance use leading to significant impairment or distress, as manifested by one or more of the following during a 12-month period<sup>12</sup>:

1. Failure to fulfill major role obligations at work, school or home, such as repeated absences or poor work performance related to substance use; substance-related absences, suspensions or expulsions from school; or neglect of children or household.
2. Frequent use of substances in situations in which it is physically hazardous (i.e., driving an automobile or operating a machine when impaired by substance use).
3. Recurrent legal problems (i.e., arrests, disorderly conduct) for substance abuse.

4. Continued use despite having persistent or recurrent social or interpersonal problems (i.e., arguments with spouse about consequences of intoxication and physical fights).

Pre-operative neuropsychology and social work notes at our institution contain highly detailed substance abuse histories (prior treatment for substance abuse, substances used and quantity, legal and marital problems related to substance use, time frame of last self-reported use), allowing for the DSM-IV criteria to be applied to patients from chart review. For patients who potentially met criteria, psychosocial and social work notes were printed and stripped of identifiers. The research team then reviewed each potential patient to determine the final substance abuse patient list. When there was not enough information in social work or neuropsychology notes regarding the timing of last drug use, provider notes, toxicology screens and psychiatry notes were accessed for additional information.

### Matched-cohort patients

Non-substance abuse patients were then selected at random, matched to each substance abuse patient in a 2:1 fashion based on implant year ( $\pm 2$  years), age at time of implant ( $\pm 5$  years) and Interagency Registry for Mechanically Assisted Circulatory Support (INTERMACS) profile from the University of Minnesota LVAD database. The database contained 364 mechanical circulatory support implants during the study period from March 2006 to November 2012.

### Exclusion criteria

Exclusion criteria were applied to both substance abuse and non-substance abuse populations. Patients who did not survive to hospital discharge or had contraindications to eventual transplantation (anatomic or otherwise) were excluded. There were no exclusion or inclusion criteria based on bridge-to-transplant (BTT) or destination therapy (DT) status. The rationale for this was based on several reasons: (1) there is a discrepancy that exists in our LVAD database between implant DT vs BTT status and eventual outcome (listed/transplanted/not), which relates to our history of designating patients based on intent; (2) most of the substance abuse patients were listed as BTT; and (3) if the matched cohort was limited to DT patients only, then these patients would have been very dissimilar to the substance abuse group, whose reason for DT status was substance abuse and not permanent comorbidities.

Among the substance abuse population, 1 patient was excluded, who did not survive to hospital discharge. In the matched cohort, there were 2 patients excluded who did not survive to hospital discharge, and 2 were excluded for congenital heart disease with no anatomic option for eventual transplant.

### Covariates

Other baseline predictors collected included: age at implant; gender; ethnicity/race; insurance type; cardiomyopathy type; presence or absence of diabetes; hypertension; creatinine, body mass index (BMI); total bilirubin; N-terminal brain natriuretic peptide (BNP); pre-operative extracorporeal membrane oxygenation (ECMO) or Impella support; non-elective intra-aortic balloon pump (IABP); and pre-operative inotropes. Other psychosocial variables collected included highest level of education, social support at the time of implant and other psychiatric diagnoses. Substance abuse histories were obtained from social work and/or

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