Obesity and Left Ventricular Assist Device Driveline Exit Site Infection

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Driveline exit site (DLES) infection is a persistent problem among the left ventricular assist device (LVAD) patients. This study investigated the relationship between obesity and DLES infection. Records of LVAD patients at two institutions from January 1999 to January 2009 were queried. Results were analyzed using t tests. Those with LVAD support ≥90 days were included. The body mass index (BMI) of each patient was measured at the time of implant and at the conclusion of LVAD support or currently, if the patient was ongoing. Other data included preimplant age, ejection fraction, blood urea nitrogen, creatinine, diabetes, New York Heart Association class, pulmonary capillary wedge pressure, VO_2 max, and inotrope therapy. The 118 patients who qualified for the study were placed in an infection group (n = 36) or in the control group (n = 82). Both groups had similar preimplant characteristics. Variables with differences statistically significant between the groups included duration of LVAD support, indication for support, device type, and BMI. Patients who developed DLES infections had a significantly higher BMI and continued weight gain over the course of LVAD therapy compared with the control group. Although this association requires further study, implications for clinical practice may include the provision of nutrition and exercise counseling for patients undergoing LVAD therapy, especially if overweight. These results may warrant increased measures to prevent and treat infection in the preimplant and postimplant periods. *ASAIO Journal* 2010; 56:57–60.

Left ventricular assist devices (LVADs) have been shown to be a viable option for the treatment of end-stage heart failure.[1] The increasing long-term use of these devices requires that associated adverse events be decreased as much as possible. Infection, specifically of the driveline exit site (DLES), remains a significant problem in LVAD patients, and once an infection is identified, it can be difficult to treat, contributing to considerable mortality and jeopardizing long-term support.[2] Further, patients' quality of life may be compromised. There are few studies that have explored body mass index (BMI) in LVAD patients.

Obesity has reached epidemic proportions worldwide[3] and is associated with increased infection rates,[4] specifically increased mortality after cardiac transplantation and poorer outcomes after cardiac surgery. One study reported that obese patients undergoing coronary artery bypass grafting had a significantly higher risk of sternal wound infection.[5] Some studies have shown that patients with a higher BMI may have a greater survival benefit after LVAD implantation.[6,8] However, higher BMI carries an increased risk of renal complications, reoperation, and dysregulated inflammatory response.[7,8] The studies that investigated this association concluded that even patients who are overweight seem to derive reasonable benefit from LVAD therapy.[6,9] No studies have specifically examined the relationship between obesity and LVAD DLES infection. The question of whether BMI plays a role in LVAD DLES infection is explored in this study. We theorize that if BMI is considered as a risk factor for DLES infection, better patient selection and management can be established.

Methods

This study specifically examined the impact of BMI on DLES infection. The study population included 118 patients from two institutions (Intermountain Medical Center and University of Utah Medical Center) implanted with LVADs over a 10-year period (March 1999 to January 2009). Patients were divided into two groups (infection n = 36 and control n = 82) based on whether they experienced a DLES infection during LVAD support. Data were collected retrospectively from each institution's patient registry. Those on LVAD support for <90 days were excluded. Subjects were implanted with the HeartMate VE or XVE (Thoratec Corporation, Pleasanton, CA), HeartMate II (Thoratec Corporation, Pleasanton, CA), Novacor (WorldHeart Corporation, Oakland, CA), and VentrAssist (Ventracor Limited, New South Wales, Australia) devices. DLES infection was characterized according to the definition by the Interagency Registry for Mechanically Assisted Circulatory Support (INTERMACS) for percutaneous site infection.[3] Average BMIs for both groups were compared at the time of LVAD implant and at the conclusion of support or currently if the patient was ongoing. This was further categorized by the type of device the patient received. t tests and Fisher exact tests were used to determine statistical significance between the groups.

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Table 1. Preimplant Characteristics

Characteristics	Infection Group (n = 36)	Noninfection Group (n = 82)	*P*
Age	59.4 ± 15.4	58.7 ± 15.5	0.823
EF	18.0 ± 4.31	18.9 ± 5.93	0.384
BUN	32.0 ± 18.3	31.4 ± 19.5	0.876
Creatinine	01.43 ± 0.056	01.57 ± 0.69	0.251
VO_2 max	10.9 ± 2.34	9.66 ± 1.04	0.171
Inotrope use	81%	68%	0.006
NYHA class	3.94	3.86	0.208
PCWP	22.1 ± 8.16	21.4 ± 7.25	0.583
Diabetes	31%	34%	0.703
BMI	29.7	26.1	0.011

EF, ejection fraction; BUN, blood urea nitrogen; NYHA, New York Hospital Association; PCWP, pulmonary capillary wedge pressure; BMI, body mass index.

Results

Preimplant variables measured include age, ejection fraction (EF), blood urea nitrogen (BUN), creatinine, VO_2 max, use of inotropes, New York Heart Association (NYHA) class, pulmonary capillary wedge pressure (PCWP), and diabetes. BMI was measured at the time of implant and at the time of the conclusion of support or currently, if support was ongoing. BMI categories were defined by the National Institutes of Health[3] and the World Health Organization. Differences in variables and significance between the two groups are detailed in **Table 1**.

Eighty-four patients were implanted with the HeartMate VE or XVE, 22 were implanted with the HeartMate II, nine patients received the Novacor, and three received the VentrAssist. Two patients with HeartMate XVE LVADs also had long-term Thoratec RVADs. Fifty-three patients (45%) were implanted as a bridge to transplant, and 62 (52%) were implanted as destination therapy. An additional two patients (3%) were implanted as "bridge-to-candidacy", with the provision that they would be eligible for transplant if criteria were met. Of note, obesity with respect to transplant eligibility was an issue for both of these patients. Twenty-four of the patients in the study (20%) had at least one device replacement, and of these, five patients received a different type of device than their original implant. All device classifications presented are by the patients' original device; subsequent device replacements are not taken into account. Device replacements were all due to mechanical failure.

Thirty-six patients (30%) were categorized as experiencing DLES infection as a complication of LVAD therapy. The average age of the study population was 58.9 ± 14.8 years; 83% were men. In this study, 2.5% of patients were underweight, 37% of patients were normal weight, 33% were overweight, and 27% were obese. The average BMI at the time of LVAD implant was 27.2 ± 6.1 kg/m^2 with a range from 15.5 to 46.9 kg/m^2. The average weight for the study population was 84.9 kg, with an average weight of 93.7 kg in the infection group and 81 kg in the noninfection group.

The two groups had similar preimplant characteristics, with no statistically significant difference with the exception of inotrope use in the preimplant period. BMI was also significantly different between the groups at the time of implant. The infection group had a mean BMI of 29.7 at the time of implant, whereas the noninfection group had a mean BMI of 26.1 (*p* value, 0.011).

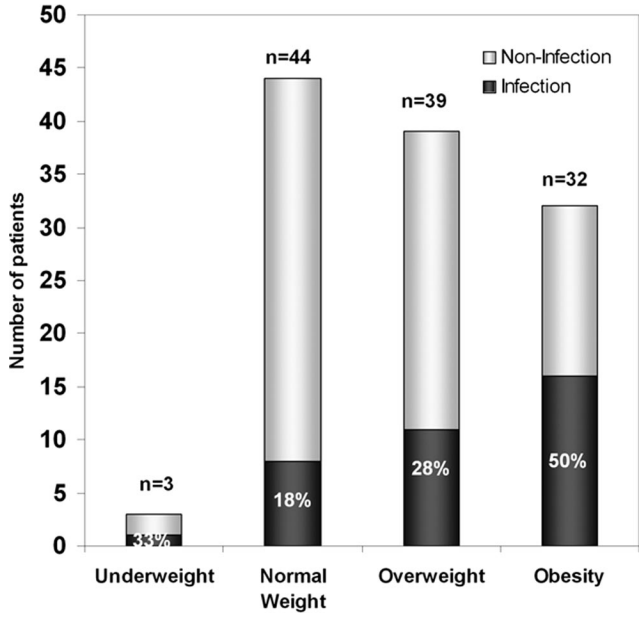

Figure 1. Analysis by body mass index (BMI) category.

When the study population was divided into BMI quartiles, the differences in infection rate became even more apparent. Of 44 patients in the normal weight group, eight patients (18%) experienced DLES infection. Eleven of 39 patients in the overweight group (28%) had infections, and 16 of 32 in the obese group (50%) experienced infections. Three patients were in the underweight group, and one patient had an infection (33%). These results are shown in **Figure 1**.

The difference in LVAD support duration was statistically significant between the groups. Patients in the infection group were on LVAD support for an average of 700 days, whereas those in the noninfection group were supported for an average of 330 days. The average support duration for all patients in the study was 445 days. **Figure 2** shows the freedom from DLES infection over the duration of support for each BMI class.

Finally, degree of obesity may also have an influence on the time of infection onset, as shown in Figure 3. In this study, obese patients tended to experience the onset of their infection during the first year of LVAD support. The overweight patients experienced the onset of infection largely during the second year of support. All the patients of normal weight who experienced infections had the onset between 6 and 18 months after the initiation of support (**Figure 3**).

Discussion

Driveline exit site infections continue to be a problem among LVAD patients. The REMATCH trial[1] reported overall infection rates of 28%, and the HeartMate II bridge-to-transplant trial[10] reported a percutaneous lead infection rate of 17%. With expanded applications for LVAD support, potential infection risks must be identified and managed. Overweight and obesity seem to be significant risk factors for developing DLES infections. When comparing the groups of patients in this study, DLES infections are more prevalent in the overweight and

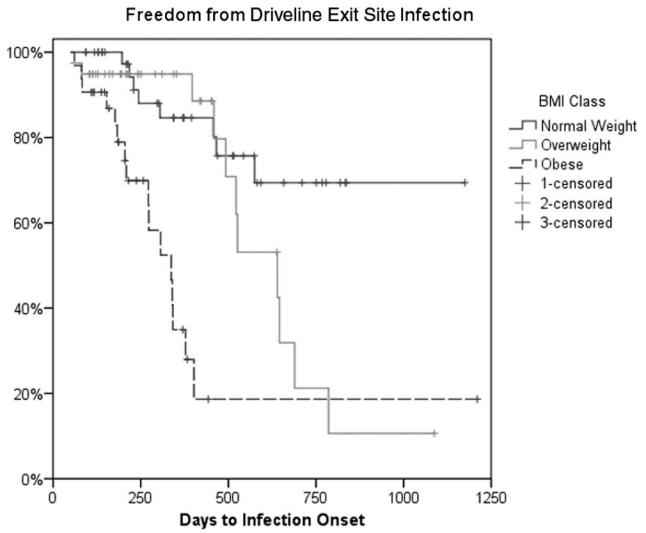

Figure 2. Freedom from infection by body mass index (BMI) category.

obese patients, and LVAD support durations are significantly longer among patients in the infection group. These findings suggest that more aggressive interventions are needed for these at-risk patients to prevent the complications of DLES infections, especially when they are receiving LVAD support for extended periods of time.

Other possible risk factors for DLES infection became apparent, including device type, the use of inotropes in the preimplant period, and the indication for receiving the device, whether for bridge to transplant or destination therapy. Patients who received Novacor LVADs had a 63% infection rate compared with 29% with HeartMate VE and XVE LVADs and 27% with HeartMate II LVADs. The infection group comprised 69% destination therapy patients, 25% bridge-to-transplant patients, and 6% "bridge-to-candidacy" for cardiac transplantation. In contrast, the noninfection group was made up of 44% destination therapy patients and 56% bridge to transplant.

Several other issues may have had an influence on infection prevalence. Patients who will have their device in place permanently and are not candidates for cardiac transplantation tend to be more chronically ill before device implantation and consequently may be more prone to infection. The increased use of preimplant inotropes in the infection group could be indicative of a population that is more ill in general, with corresponding deficiencies in wound healing, such as poor nutrition and possible hepatic and renal dysfunction. It could also be theorized that patients who are supported by a device for an extended period of time have a greater chance of developing infection, simply by spending more time with an implanted device.

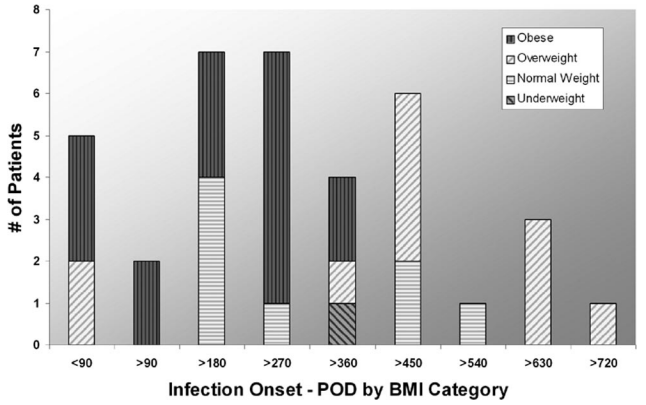

Figure 3. Time to infection onset by body mass index (BMI) category.

In addition, obesity may be contributing to increased DLES infections by creating problems such as hygiene issues and excess adipose tissue in the abdominal area that receives less blood supply and contributes to less stability and poor healing. Some studies have found a dysregulated immune response,[4] increased infection rates, and bacterial colonization to be associated with obesity.[11]

There may be various interventions used to help prevent DLES infections in these patients. Implanting LVADs in overweight patients with the hope that they will lose weight has not been successful at the reporting institutions. In this study, those in the infection group actually tended to gain weight over the duration of LVAD support. Techniques such as preimplant infection surveillance and cultures, postoperative prophylactic antibiotic cycling, and improved methods of stabilizing the DLES are potentially useful practices that are currently being investigated. The latter method in particular has been successful in reducing DLES infections at Intermountain Medical Center in recent years with the institution of a foam dressing technique. Bariatric surgery is another possible method that may assist patients in losing weight, therefore potentially preventing infection and possibly becoming transplant eligible. There is no data published on this method of weight loss with LVAD patients, but it has been met with some success in reducing left ventricular dysfunction in obese patients with heart failure.[12,13] Use of this option in this patient population will require further exploration in the future. Nutrition and exercise counseling may also be offered to patients who are overweight or obese before LVAD implantation and throughout support as a means to combat this problem.[14] This reinforces the need for collaboration with an interdisciplinary team to manage the needs of these complex patients.

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