

## The Efficacy of Acticoat-Silver Dressing in Preventing Left-ventricular-Assisted Device Infections

Hadeel Zainah<sup>1\*</sup>, Aarthee Karthikeyan<sup>1</sup>, Pablo Buitron<sup>2</sup>, Mehnaz Rahman<sup>2</sup>, Douglas Jennings<sup>3</sup>, Suzan L Davis<sup>3</sup>, George Alangaden<sup>1</sup>, Daniela Moreno<sup>1</sup>, Fadi Samaan<sup>4</sup>, Sarah Al Helou<sup>1</sup>, Ghattas Alkoury<sup>1</sup>, Wassim Stephane<sup>1</sup>, Salim Daikh<sup>1</sup> and Mayur Ramesh<sup>1</sup>

<sup>1</sup>Division of Infectious Diseases, Henry Ford Hospital, Detroit, Michigan, USA

<sup>2</sup>Department of Internal Medicine, Henry Ford Hospital, Detroit, Michigan, USA

<sup>3</sup>Department of Pharmacy, Henry Ford Hospital, Detroit, Michigan, USA

<sup>4</sup>Rhode Island Hospital, Providence, RI, USA

### Abstract

**Background:** The optimal local care of continuous-flow left ventricular-assisted device (CF-LVAD) exit site in unclear. We compared silver-coated wound dressing (Acticoat) with the conventional wound care method.

**Methods:** A retrospective case-control study was conducted at Henry Ford Hospital, a tertiary teaching hospital in urban Detroit, between 11/1/2010 and 12/31/2011. Patients were divided into 2 groups based on Acticoat-dressing use. Primary outcome was first CF-LVAD infection rate.

**Results:** Forty-two patients were included in the study. Twenty patients used Acticoat-dressing, while 22 used the control dressing. Mean age was  $60.3 \pm 8.9$  in the intervention group and  $48.6 \pm 4.8$  in the control group ( $P: 0.004$ ). Male patients were 15 (75%) in the intervention group and 15 (68.2%) in the control group ( $P: 0.74$ ). Acticoat-dressing was used for a mean duration of  $64.1 \pm 122.9$  days. The rate of first CF-LVAD infection was 15% (3) in the Acticoat group and 31.8% (7) in the control group ( $P: 0.25$ ). Mortality at 200 days was 15% (3) in the intervention group; and 4.5% (1) in the control group ( $P: 0.25$ ). Ten patients were infected in the whole study (23.8%); 9 of the infected patients (90%) required hospitalization after the first infection; while 3 patients (30%) required intensive-care unit admission. Mean time to the first infection was  $276.3 \pm 235.8$  days in the intervention group and  $276.3 \pm 131.5$  days in the control group ( $P: 0.99$ ).

**Conclusion:** There was no statistically significant difference in the infection rate or time to first infection between the Acticoat group and the control group.

**Keywords:** LVAD; Acticoat; Infection; Implantation

### Introduction

Implantation of continuous-flow left-ventricular-assisted device (CF-LVAD) has been consistently shown to reduce mortality rate, alleviate symptoms, improve organ perfusion, and facilitate transplantation for patients with end-stage heart failure [1]. CF-LVAD could be either a destination therapy or a bridge to transplant. It provides survival benefit over medical treatment [1]. The procedure could be complicated with early infection (within the first 100 day) and late infection (100 days to 1 year) [2]. Infection could involve the driveline exit-site, the device pocket or the pump/cannula [1]. These infectious complications increase the morbidity and mortality in this population [1]. The rate of infection depends on multiple factors like the location of the device, the type of device and the driveline exit-site care. Local care plays a crucial role in preventing infectious complications; however, the optimal local care method for the percutaneous driveline is still unclear. Previously, the initial post-operative wound care involved daily or twice daily dressing changes with a local disinfectant (chlorhexidine). More recently, a silver-coated wound dressing (Acticoat) that only requires changing every 72 hours was recently introduced as part of the standard topical hygiene measures in patients with CF-LVAD. To date there are limited data describing the effect of this particular method of local wound care on the epidemiology and incidence of post-operative infections in this patient population. The goal of this study was to evaluate the efficacy of Acticoat-based dressing in preventing CF-LVAD infection.

### Methods

#### Study design

It is a two-phase quasi-experimental study conducted on the included patients in Henry Ford Hospital, a tertiary teaching hospital in

urban Detroit. Data collected included information about age, gender, race, comorbidities, body mass index (BMI), baseline creatinine clearance, the use of Acticoat-based dressing, the duration for which Acticoat-dressing was used (if Acticoat-based dressing was used), type and pathogen of CF-LVAD-infection, time to first infection, length of admission if the patient required hospitalization, intensive-care unit (ICU) admission requirement, ICU length of stay and number of CF-LVAD-related infections in the follow-up period.

#### Inclusion criteria

We included all the patients who received CF-LVAD implantation between 11/1/2010 and 12/31/2011.

#### Exclusion criteria

We excluded the patients who received CF-LVAD outside of the determined time frame, died within the first 72 hours after the procedure, received implantation of ventricular assist devices other than CF-LVAD or who had follow-up care at another institution

**\*Corresponding author:** Hadeel Zainah, The Miriam Hospital, Providence, RI, 02906, United States of America, Tel: 401-793-2104; E-mail: [zainahhadeel@yahoo.com](mailto:zainahhadeel@yahoo.com)

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## Definitions

Day 0 was considered the day of CF-LVAD placement. Follow-up duration was considered the number of days between day 0 and 8/31/2012 or the last day the patient was seen by a physician before 8/31/2012. Cases were defined as subjects who met the inclusion criteria and used Acticoat- based dressing between day 0 and the end of follow-up duration; while controls were defined as subjects who met inclusion criteria and used the traditional dressing for local care between day 0 and the end of follow-up duration. CF-LVAD-related infections included CF-LVAD-specific infections and CF-LVAD-related infections. CF-LVAD-Specific infections included driveline infection, pump pocket infection and device infection (3); while CF-LVAD-related infections included blood stream infection (BSI), endocarditis, and mediastinitis (3).

The primary outcome was the rate of the first CF-LVAD infection; secondary outcomes were all-cause mortality within the first 200 days of follow-up period, admission rate due to CF-LVAD infection, CF-LVAD change due to CF-LVAD infection, and mean time to first infection.

## Results

Forty two patients were included in the study. Twenty patients used Acticoat-dressing (intervention group) while 22 used the conventional method (control group). Mean age was  $60.3 \pm 8.9$  in the intervention group and  $48.6 \pm 14.9$  in the control group (P: 0.004). 75% (15) were males in the intervention group and 68.2% (15) were males in the control group (P: 0.738). Baseline characteristics are shown in Table 1. Acticoat-dressing was used for a mean duration of  $64.1 \pm 122.9$  days in the intervention group. The rate of the first CF-LVAD infection was 15% (3 patients/20) in the acticoat group and 31.8% (7 patients/22) in the control group (P: 0.248). Mortality analysis at 200 days post-implantation showed that 3 (15%) patients died in the intervention group; while 1 (4.5%) patient died in the control group (P: 0.249). Mortality rate at the end of follow-up duration was 50% in both groups. Results are also shown in Table 2.

Ten patients were infected in the whole study (23.8%); 9 of the infected patients (90%) required hospitalization after the first CF-LVAD infection; while 3 patients (30%) required ICU admission. None of the infected patients received heart transplant or underwent CF-LVAD replacement. The mean time to the first infection was  $276.3 \pm 235.8$  days in the intervention group and  $276.3 \pm 131.5$  days in the control group (P: 0.9997).

## Discussion

CF-LVAD implantation has improved the survival of patients with end stage congestive heart failure, both as a bridge to cardiac transplant and, increasingly as a destination therapy. CF-LVAD infection has implications in morbidity, mortality and hospital length of stay [1,3]. Slaughter et al. showed that CF-LVAD infection incidence was 0.48 event per patient year which is less than the incidence of infection in pulsatile left ventricular assisted device (LVAD) (0.9 per patient year) [4]. Infections in these patients also incur a higher economic burden as these patients tend to have longer recovery time and require more hospitalizations [5]. Cost analysis also shows that sepsis is the most important predictor of cost [6]. Antimicrobial topical wound care for CF-LVADs is a simple intervention that is now routine despite the paucity of research on its efficacy. Our study sought to examine the difference between the newer agent Acticoat silver dressing and the current standard of care, chlorhexadine. To our knowledge, this is the first study to do so.

Variable	Controls 22	Cases 20	P value
Mean age	48.6 ± 14.83	60.3 ± 8.87	0.004 (T)
Race			
Caucasian	8 (36.4%)	10 (50%)	0.83 (C)
Black	9 (40.9%)	7 (35%)	-
Hispanic	2 (9.1%)	1 (5%)	-
Other	3 (13.6%)	2 (1%)	-
Male	15 (68.2%)	15 (75%)	0.74 (C)
Mean creatinine	1.3 ± 0.85	1.3 ± 0.66	0.90 (T)
Mean GFR	78.6 ± 35.44	62.8 ± 20.88	0.09 (T)
Mean BMI	28.6 ± 5.51	28.7 ± 5.65	0.96 (T)
Tobacco	6 (27.3%)	6 (30%)	0.85 (C)
Alcohol	3 (13.7%)	5 (25%)	0.45 (C)
HTN	17 (77.3%)	17 (85%)	0.52 (C)
DM	9 (40.9%)	9 (45%)	0.79 (C)
CKD	13 (59.1%)	6 (30%)	0.06 (C)
ESRD	1 (4.5%)	0 (0%)	1.0 (C)
COPD	4 (18.2%)	5 (25%)	0.71 (C)
Malignancy	1 (4.5%)	3 (15%)	0.33 (C)
Steroid use	1 (4.5%)	1 (5%)	1.0 (C)
Immunosuppression	0(0%)	1(5%)	0.48(C)

**Table 1:** Baseline characteristics. GFR: glomerular filtration rate, BMI: body mass index, HTN: Hypertension, DM: Diabetes Mellitus, CKD: Chronic Kidney disease, ESRD: End-stage- renal disease, COPD: Chronic obstructive pulmonary Disease, C: Chi square, T: T test.

Variable	Controls 22	Cases 20	P value
First infection	7 (31.8%)	3 (15%)	0.25 (C)
Mean time to first infection	276.3 ± 131.53	276.3 ± 235.71	0.99 (T)
Mean follow-up duration	503.3 ± 170.4	288.75 ± 134.02	0.0001 (T)
Death at 200 days	1 (4.5%)	3 (15%)	0.25 (C)
Death at end of follow-up	2 (50%)	2 (50%)	0.29 (C)

**Table 2:** Results. C: Chi Square, T: T test.

Our study reveals that the control group had more infections than the Acticoat group, however, this was statistically insignificant. Another important outcome was the time to first CF-LVAD related infection; this was essentially the same between the groups (P=0.999). The 200 day all-cause mortality was three times higher in the intervention group compared to the Acticoat group; the difference was not statically significant either. This numerical difference might be explained by the increased age in Acticoat group. However; mortality rate at the end of follow-up duration was similar in both groups. Of note, 90% of the total infected patients required hospitalization which only underscores the high morbidity in this population.

Our incidence of infection as well as subsequent hospitalization is comparable with rates found in other major studies of CF-LVAD infection [7]. Although our sample size was smaller than most studies, it was representative [2]. Another study shows that late driveline infections (median time to infection 158 days) also appeared in about 23% of patients and once present, increased mortality and decreased 5-year-survival from 70% to 40% [2]. The mortality in our population was higher compared to the literature that shows an average mortality attributable to LVAD infection of 15%-44% [8].

In terms of baseline demographics, it is important to mention that age was lower in the control group compared to the Acticoat group. The Acticoat group had lower number of patients with CKD compared with the control group. There is inconclusive data supporting CKD

as a predisposing factor to increased CF-LVAD infections. Although there is a statistically significant difference in the mean age, numerous studies failed to show a relationship between demographic factors, including age, and CF-LVAD related infections [3].

Limitations of this study include those related to a retrospectively performed analysis which specifically precludes randomization and blinding. It was not possible to control for confounding factors due to the nature of the study however a regression analysis was performed to identify those confounders. Another limitation was the widely variable follow-up period for the subjects which can increase the rate of infection incidence depending on the latency of follow up. It was also difficult to ensure that patients were adherent to dressing changes. Additionally, the exact duration of Acticoat-based dressing could not be established due to lack of documentation.

The decreased frequency of dressing changes (every 72 hours in Acticoat vs. daily or twice daily in Chlorhexadine) may confer some advantages. An often overlooked point in the CF-LVAD patients is that they desire and attempt to regain normalcy through social interactions and activities away from home as their heart failure symptoms improve [9]. This can often be restricted by daily/BID dressing changes. It is also known that compliance is negatively affected by more frequent treatments. Furthermore, patients that normally require assistance with the task of changing will be less reliant on caregivers.

In conclusion, the results of our study did not demonstrate a statistically significant difference in the infection rate, time to first infection, or 200 day all-cause with Acticoat use in comparison to the current standard but it may prove to be a more time-efficient alternative.

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