*Artificial Organs*

WILEY

MAIN TEXT OPEN ACCESS

# Efficacy of Antimicrobial Silver-Plated Dressings Compared to Usual Care in Preventing Left Ventricular Assist Device Driveline Infections

Barbara Veiter[1] | Martina Socha[1] | Christiane Marko[1] | Nesibe Seyda Colak[1] | Alexandra Kuhn[1] | Hebe Al Asadi[1] | Julia Riebandt[1] | Roxana Moayedifar[1] | Daniel Zimpfer[1] | Thomas Schlöglhofer[1,2]

[1]Department of Cardiac and Thoracic Aortic Surgery, Medical University of Vienna, Vienna, Austria | [2]Center for Medical Physics and Biomedical Engineering, Medical University of Vienna, Vienna, Austria

**Correspondence:** Thomas Schlöglhofer (thomas.schloeglhofer@meduniwien.ac.at)

**Received:** 15 June 2026 | **Revised:** 27 July 2026 | **Accepted:** 30 July 2026

**Keywords:** driveline | driveline exit site | driveline infection | left ventricular assist device | prevention | silver-based wound dressings | wound healing

## ABSTRACT

**Background:** Left ventricular assist device (LVAD) driveline infections (DLIs) represent one of the most common adverse events in LVAD patients. This study investigates the effectiveness of a silver-plated antimicrobial dressing (Silverlon, Bravida Medical) in addition to usual driveline wound care for DLI-prevention. The primary outcome was six-months freedom from DLI. Secondary outcomes included independent risk factors for DLI, freedom from DLI-related hospital readmission, freedom from negative pressure wound therapy (NPWT) and temporal changes in DESTINE wound staging.

**Methods:** This single center cohort study included 61 patients implanted with a HeartMate 3 LVAD between 2022 and 2025 (8.2% female; median age 61 (55; 67 IQR) years; BMI 27.2 (±4.42 STD) kg/m$^2$). Starting with the first follow-up visit (FFUV) after hospital discharge, 39 patients received usual wound care, while 22 patients additionally received Silverlon.

**Results:** The Silverlon group demonstrated a significantly greater freedom from DLI (100% vs. 71.8%; $p = 0.017$). No independent predictors of DLI were identified due to the complete absence of DLIs in the Silverlon group (0 vs. 11 events); multivariable Cox regression effect could not be mathematically estimated. The Silverlon group showed 100% freedom from DLI-related readmission and NPWT therapy (vs. 97.4%; $p = 0.45$). DESTINE stages 0–1 predominated within the Silverlon group; severe stages (3, 4) occurred exclusively within the usual care group ($p > 0.22$).

**Conclusion:** Given the substantial burden of DLI, integrating silver-plated wound dressings into standard LVAD wound care appears to be a safe and effective strategy, associated with enhanced wound healing and a reduction in DLI incidence.

## 1 | Introduction

Continuous-flow left ventricular assist devices (LVADs) have fundamentally transformed the management of end-stage heart failure, offering significant long-term life prolongation for these patients [1]. Recent clinical data demonstrate robust survival benefits, with survival rates reaching 85.9% at 1 year, 60.2% at 5 years, and 51.8% at 7 years [2]. However, despite these profound survival gains, adverse events (AEs)—including infection, right-heart failure, bleeding, or stroke—remain a substantial burden that compromises clinical success and impairs quality of life (QoL) [3]. To establish LVAD support as a clinically and socially

**Abbreviations:** AE, Adverse events; BMI, Body mass index; DESTINE, Driveline Expert STagINg and carE; DLES, Driveline exit site; DLI, Driveline infection; DT, Destination therapy; FFUV, First follow-up visit; IQR, Interquartile range; ISHLT, International Society for Heart and Lung Transplantation; LVAD, Left ventricular assist device; MCS, Mechanical circulatory support; NPWT, Negative pressure wound therapy; QoL, Quality of life.

Meeting Presentation: Parts of this work were presented at the 46th ISHLT Annual Meeting, Toronto, ON, Canada, 22–25 April 2026.

successful treatment option for all stakeholders—including patients, caregivers, and health care providers—the clinical focus must expand beyond minimizing AE rates to actively enhancing patient QoL [4]. Driveline infections (DLI) continue to compromise both survival outcomes and patient QoL due to increased hospital readmissions, prolonged antibiotic therapy, and surgical intervention, underscoring the critical necessity of robust prevention strategies [5].

Despite the clinical success LVADs contribute to, DLIs pose a serious AE with approximately 30% of LVAD patients suffering from DLIs and up to 13% experiencing a hospital readmission, which makes it the number one cause of readmissions in all recipients within the first two-years of support [6]. The International Society for Heart and Lung Transplantation (ISHLT) defines three major LVAD specific infection types, which include non-VAD infections, VAD-related infections and VAD-specific infections [7, 8]. Especially VAD-specific infections including components such as the driveline are crucial for the development of DLIs [8].

The LVAD DL connects the internal pump with the external controller and power sources, which results in a potential entry point for bacteria due to the artificial opening in the abdominal wall [9]. The DLs design creates an excellent environment for the formation of biofilms, which provides an ideal breeding ground for bacteria [10]. Patient-related risk factors for the development of DLIs include comorbidities such as diabetes, obesity and chronic kidney diseases [11, 12]. Furthermore, modifiable risk factors such as driveline features and material [13], anchoring devices [14] and proper driveline exit site (DLES) care are essential for DLI prevention [15].

Despite numerous published guidelines and consensus statements [7, 11], DLES care remains unstandardized due to the wide variety of dressing techniques and management protocols utilized across centers. Specifically, the integration of antimicrobial silver-plated materials into the dressing procedure may play a pivotal role in reducing microbial colonization at the DLES [15]. The broad-spectrum antimicrobial activity of silver is mediated by the release of silver ions, which penetrate and damage microbial cells, ultimately disrupting biofilm integrity. Consequently, silver effectively neutralizes a wide range of bacterial, viral, and fungal pathogens, thereby facilitating an optimized healing environment [16].

The primary outcome of this study was six-month freedom from DLI, comparing LVAD patients receiving standard DLES care with those receiving supplemental silver-plated antimicrobial wound dressings. As secondary outcomes, the study elaborated independent risk factors for DLI, the freedom of DLI-related hospital readmission, freedom of negative pressure wound therapy (NPWT), and temporal changes in DESTINE [11] wound staging.

## 2 | Material and Methods

### 2.1 | Study Design and Study Population

This explorative, single-center cohort study included adults supported by the HeartMate 3 (HM3; Abbott of Chicago, Chicago, IL, USA) LVAD at the Medical University of Vienna between 2022 and 2025. The study population comprised a control group receiving usual care ($n = 39$) and an intervention group ($n = 22$) receiving usual care supplemented with silver-plated antimicrobial dressings (Silverlon IVCD 70; Bravida Medical, Geneva, Illinois) (Figure 1).

Exclusion criteria included age under 18 years, requirement for biventricular assist device or a total artificial heart support, and presence of DLI at the first outpatient follow-up. Additionally, patients were excluded if clinical records were unavailable or if they failed to adhere to the scheduled outpatient follow-up protocol. The study protocol was approved by the Institutional Review Board (identification number: EK-1839/2022) with a waiver for informed consent.

Patient data including laboratory parameters, microbiological swabs and modified DESTINE wound stage [11] was assessed at each coordinated time point which consisted of first follow up visit (FFUV), 1 month post FFUV, 3 months post FFUV and 6 months post FFUV. DLES stages were classified using a modified version of the DESTINE wound staging with deep infections beginning at DESTINE stage 3 [17]. Stages are classified as follows: 0 = no infection, 1 = no infection/local wound healing disorder, 2 = local infection, 3 = systemic infection, 4 = systemic infection with increased severity, 5 = progressive systemic infection with deep DLI and/or signs for ascending infection [11]. In stages 0 and 1 no microbiological swabs and blood culture results were carried out. Staging was assessed based on the

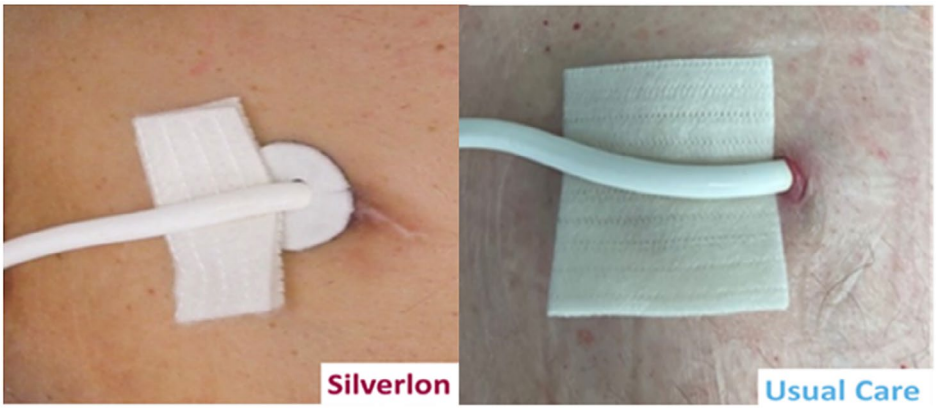


**FIGURE 1** | Wound dressing with (left) and without (right) Silverlon. [Color figure can be viewed at wileyonlinelibrary.com]

visual wound presentation and clinical data, either by the examining wound manager or via photographic documentation. The step-by-step protocol for a complete wound dressing change in patients presenting with DESTINE Stage 0 can be found in Figure S1.

The primary outcome was defined by the freedom of DLI occurrence at 6-months post FFUV stratified by usual care vs. the Silverlon intervention group. Secondary endpoints included independent risk factors for DLI, freedom of DLI-related hospital readmission, freedom of NPWT therapy, and temporal changes in DESTINE wound staging.

### 2.2 | Statistical Analysis

Baseline demographics were assessed as mean ± standard deviation for normally distributed or median (IQR) for non-normally distributed continuous variables and counts (percentages) for categorical variables. Normality was tested using the Shapiro–Wilk test. In cases of normal distribution of continuous variables, the *t*-test was used, otherwise, the Mann–Whitney-*U*-test was employed. The Fisher's exact test was used for categorical variables. A multivariable Cox regression analysis was applied to evaluate the impact of the intervention on DLIs within the first 6 months after the FFUV, controlling for baseline demographics and confounding clinical risk factors. Variables demonstrating an association at an univariable threshold of $p < 0.20$—including treatment group, age, diabetes mellitus, and BMI—were systematically entered into the adjusted multivariable model. The primary outcome and secondary outcomes stratified by usual care vs. Silverlon were assessed using the Log-Rank test and were graphically presented with Kaplan–Meier curves. Temporal DESTINE staging changes were conducted with the Fishers exact test. Statistical significance was defined as a two-sided $p < 0.05$. All statistical analyzes were performed using SPSS Statistics for Windows, version 29.0 (IBM Corp., Armonk, NY, USA).

## 3 | Results

### 3.1 | Baseline Demographics

A total of 61 patients on LVAD support were included in this study, comprising a usual care group ($n = 39$, 64%) and a Silverlon group ($n = 22$, 36%) that received standard care supplemented with silver-plated antimicrobial wound dressings. The study population was predominantly male (91.8%), with a median age at surgery of 61 years (IQR: 55; 67). The most common underlying disease for heart failure was ischemic cardiomyopathy (50.8%). Baseline clinical and demographic characteristics were well-balanced between the two groups, particularly regarding risk factors compromising wound healing, including BMI, diabetes mellitus, age, and alcohol or tobacco abuse (Table 1).

### 3.2 | Primary Outcome

Freedom from DLI at 6 months post FFUV differed significantly between the two groups ($p = 0.017$), demonstrating 100% freedom from DLI in the Silverlon group compared to 71.8% in the usual care group (Figure 2). For patients who developed an infection, the median time from implant to the first DLI episode was 154 days (IQR: 40; 206). Overall, the usual care group exhibited a significant higher occurrence of positive microbiological swabs ($p = 0.03$), with gram-positive bacteria identified as the most frequent pathogens (Table S2).

### 3.3 | Secondary Outcomes

Univariate analysis identified six variables with a $p < 0.20$, specifically age, treatment group (usual care vs. Silverlon), BMI, INTERMACS level, diabetes mellitus, and indication for LVAD implantation—which were subsequently entered into the multivariable Cox regression analysis (univariate results detailed in Table S1). In the multivariable model, no independent predictors of DLI were identified (Table 2). Although age demonstrated a significant association in univariate analysis (HR: 0.94, 95% CI: 0.90–0.98, $p < 0.01$), this relationship was not retained after adjustment. Due to a complete absence of DLIs in the Silverlon group (0 events at 6 months post FFUV) compared to the usual care group (11 events), the HR and CI for the treatment effect could not be mathematically estimated (Table 2).

Furthermore, the Silverlon group showed 100% freedom from DLI-related readmission and NPWT therapy vs. 97.4% in the usual care group ($p = 0.45$) with no statistically significant difference (Figures S2 and S3; Table S2).

Regarding the temporal changes of wound healing, DESTINE stages 0–1 predominated within the Silverlon group throughout the follow-up period. Conversely, isolated instances of severe stages (3, 4) occurred exclusively within the usual care group, though these longitudinal variations did not reach statistical significance at any evaluated time point ($p > 0.22$) (Table S2).

## 4 | Discussion

This study evaluated the clinical efficacy of a silver-plated antimicrobial wound dressing (Silverlon) compared with usual care for the prevention of DLIs in patients supported by the HM3 LVAD. Notably, no DLIs occurred within the Silverlon cohort during the follow-up period. This absolute risk reduction can be primarily attributed to the antimicrobial silver intervention, as identical DLES best practices and a highly standardized dressing protocol were maintained uniformly across both patient cohorts.

DLIs remain one of the most persistent and severe long-term complications of MCS [2, 18], severely degrading QoL [4], thereby introducing significant mortality risks through potential tracking to deep tissue structures or the development of systemic bloodstream infections [19]. Our findings indicate that routine use of a silver dressing for post-operative DLES care not only delays the potential onset of complications but renders the clinical manifestation of initial infectious events entirely absent, representing a significant advancement relative to conventional DLES management protocols.

**TABLE 1** | Baseline demographics.

| Variable *n* (%), mean ± SD or median (IQR) | Silverlon *n* = 22 | Usual Care *n* = 39 | *p* |
|---|---|---|---|
| Patient characteristics | | | |
| Age | 64 (57.0; 71.0) | 60 (52.5; 66.5) | 0.11 |
| Gender | | | |
| Male | 21 (95.5%) | 35 (89.7%) | 0.65 |
| Female | 1 (4.5%) | 4 (10.3%) | |
| BMI at implantation | 26.49 ± 4.26 | 27.61 ± 4.51 | 0.35 |
| Cause of CMP | | | 0.24 |
| Dilated | 11 (50.0%) | 9 (23.1%) | |
| Ischemic | 9 (40.9%) | 22 (56.4%) | |
| Toxic | 0 | 1 (2.6%) | |
| Mixed | 2 (9.1%) | 6 (15.4%) | |
| Unknown | 0 | 1 (2.6%) | |
| INTERMACS level | | | |
| 1 | 3 (13.6%) | 10 (25.6%) | |
| 2 | 5 (22.7%) | 14 (35.9%) | 0.27 |
| 3 | 5 (22.7%) | 7 (17.9%) | |
| 4 | 9 (40.9%) | 8 (20.5%) | |
| Preoperative comorbidities | | | |
| Diabetes mell. | | | |
| Yes | 6 (27.3%) | 15 (38.5%) | 0.42 |
| No | 16 (72.7%) | 24 (61.5%) | |
| Tobacco abuse | | | |
| Yes | 13 (59.1%) | 26 (66.7%) | 0.59 |
| No | 9 (40.9%) | 13 (33.3%) | |
| Alcohol abuse | | | |
| Yes | 8 (36.4%) | 13 (33.3%) | 1.0 |
| No | 14 (63.6%) | 26 (66.7%) | |
| Intraoperative variables | | | |
| Indication | | | |
| DT | 11 (50.0%) | 13 (33.3%) | |
| BTC | 10 (45.5%) | 19 (48.7%) | 0.27 |
| BTT | 1 (4.5%) | 7 (18.0%) | |
| Bypass support | | | |
| HLM | 20 (90.9%) | 32 (82.1%) | 0.75 |
| Offpump | 1 (4.5%) | 4 (10.3%) | |
| ECMO | 1 (4.5%) | 3 (7.7%) | |
| Minimal invasive implant | | | |
| Yes | 5 (22.7%) | 12 (30.8%) | 0.57 |
| No | 17 (77.3%) | 27 (69.2%) | |
| Distal anastomosis | | | |
| Aorta asc. | 19 (86.4%) | 36 (92.3%) | 0.66 |
| A. subcl. sin. | 3 (13.6%) | 3 (7.7%) | |
| DL double tunneling technique | | | |
| Yes | 22 (100%) | 31 (79.5%) | **0.04** |
| No | 0 | 8 (20.5%) | |
| Postoperative variables | | | |
| Velour exposure FFUV | | | |
| Yes | 3 (20.0%) | 2 (6.5%) | 0.31 |
| No | 12 (80.0%) | 29 (93.5%) | |

*Note:* Bold values indicate significance at $p < 0.05$.

Abbreviations: A. subcl. sin., Arteria Subclavia Sinister; Aorta asc., Aorta Ascendens; BMI, body mass index; BTC, bridge to candidacy; BTT, bridge to transplant; CMP, cardiomyopathie; DL, driveline; DT, destination therapy; ECMO, extracorporeal membrane oxygenation; FFUV, first follow-up visit; HLM, heart-lung machine.

The clinical success observed in the Silverlon group can be largely attributed to the proprietary silver-plated technology that delivers continuous high-density silver ions directly to the percutaneous wound interface, which effectively suppressed microbial colonization. Within modern wound care management, silver plays an increasingly critical role, particularly in anatomically vulnerable sites with an inherently high risk of infection, such as DLES [20, 21]. This potent antimicrobial efficacy is driven by two primary distinct forms: silver cations and silver nanoparticles. Silver cations can exert direct bactericidal effects by inflicting direct membrane injury and denaturing bacterial DNA and RNA via binding to intracellular proteins, which ultimately inhibits replication. Simultaneously, silver nanoparticles bind to the bacterial cell membrane, causing structural disruption. Upon penetrating the cell, they can alter intracellular compounds and promote protein denaturation and oxidative stress, ultimately damaging vital microbial proteins and lipids [20, 22]. Because silver simultaneously targets multiple bacterial structures and biochemical pathways, the probability of resistance development remains exceptionally low [23]. This broad-spectrum efficacy is critical in LVAD management, where the DLES is chronically exposed to problematic nosocomial and commensal skin pathogens [7, 11, 15].

Our results align with a growing body of evidence validating the therapeutic value of silver-plated protocols. In the large-scale

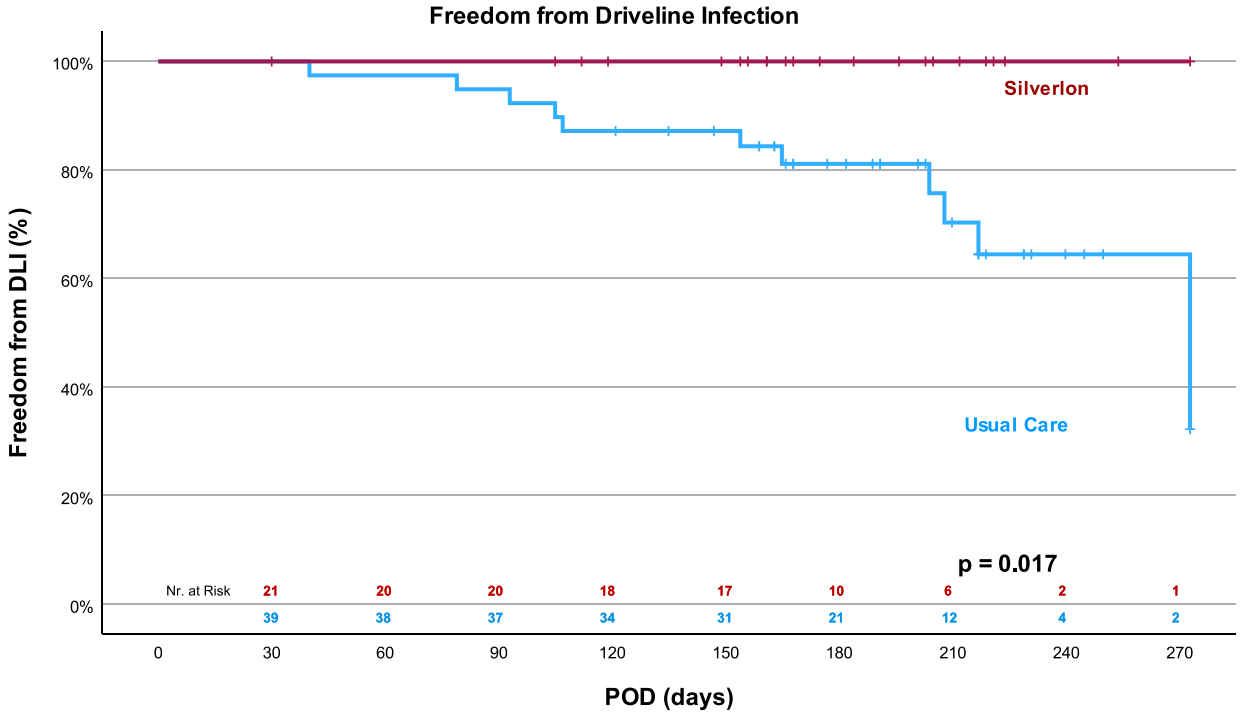


**FIGURE 2** | Freedom from DLI stratified by group (Silverlon 100% vs. Usual Care 71.8%; $p = 0.017$). DLI, driveline infection; POD, postoperative day. [Color figure can be viewed at wileyonlinelibrary.com]

**TABLE 2** | Multivariable Cox regression analysis.

| | Univariable analysis | | | Multivariable analysis | | |
|---|---|---|---|---|---|---|
| **Characteristics** | **HR** | **95% CI** | ***p*** | **Adjusted HR** | **95% CI** | ***p*** |
| Group(silverlon vs. usual care) | 0.03 | 0.00–4.73 | 0.17 | -[a] | -[a] | 0.95 |
| Age (years) | 0.94 | 0.90–0.98 | **< 0.01** | 0.94 | 0.83–1.07 | 0.36 |
| BMI (kg/m$^2$) | 1.11 | 0.97–1.27 | 0.12 | 1.10 | 0.93–1.30 | 0.28 |
| INTERMACS level | | | 0.14 | | | 0.27 |
| 1 | 0.42 | 0.04–4.86 | 0.49 | 0.11 | 0.00–3.13 | 0.20 |
| 2 | 3.89 | 0.70–21.44 | 0.12 | 1.09 | 0.12–11.04 | 0.94 |
| 3 | 0.90 | 0.07–10.84 | 0.93 | 4.50 | 0.22–92.80 | 0.33 |
| 4 | Ref. | | | Ref. | | |
| Diabetes mellitus (yes) | 0.34 | 0.07–1.64 | 0.18 | 0.22 | 0.02–3.19 | 0.27 |
| Indication | | | **0.01** | | | 0.28 |
| DT | Ref. | | | | | |
| BTC | 5.94 | 1.03–34.10 | **0.05** | 3.90 | 0.30–56.32 | 0.32 |
| BTT | 1.24 | 0.11–13.77 | 0.86 | 0.63 | 0.03–12.80 | 0.76 |

*Note:* Bold values indicate significance at $p < 0.05$.

Abbreviations: BMI, body mass index; BTC, bridge to candidacy; BTT, bridge to transplant; CI, confidence interval; DT, destination therapy; HR, hazard ratio.

[a]In the Silverlon (intervention) group, no events occurred during the follow-up period. As a result, the standard maximum likelihood estimate for the adjusted Hazard Ratio (HR) could not be mathematically computed (infinite estimate).

ASPIRE multi-center study encompassing 30 experienced LVAD centers, Cowger et al. [21] demonstrated that silver-plated dressings in combination with chlorhexidine reduced early device-related infections by 52% and late infections by 36%. Similarly, Cagliostro et al. [24] showed that silver-plated dressing kits utilizing anchoring devices significantly decreased DLI rates (from 0.18 to 0.07) and lowered DLI-related readmission rates from 0.08 to 0.03 events per patient-year. Furthermore, in a systematic review of DLES protocols, Koken et al. [15] concluded that silver-plated dressings are highly effective at preventing infections

when applied to dry, uninfected, and healed DLES, underscoring silver's established utility in modern wound management. Most definitively, a prospective randomized trial by Baudart et al. [5] demonstrated that evaluating the same silver-plated antimicrobial wound dressings (Silverlon) used in our study demonstrated reductions in both the time for first DLI ($p=0.01$) and the total DLI rate ($p=0.002$). Silver-plated coatings provide sustained broad-spectrum antimicrobial activity by releasing silver ions, generating ROS, and disrupting bacterial cell membranes, thereby inhibiting pathogen growth and biofilm formation. This makes them an effective strategy for infection prevention on medical devices and wound dressings [25, 26].

However, effective DLI mitigation cannot rely on a single "silver bullet" intervention; rather, it demands a highly coordinated, multifactorial strategy spanning surgical technique, mechanical stabilization [14], and rigorous hygiene protocols [11]. Advanced surgical approaches, such as the driveline double-tunneling technique [27, 28], establish a prolonged intrafascial pathway within the rectus sheath and subcutaneous tissue that inherently resists ascending bacterial colonization. A higher proportion (100% vs. 79.5%) of patients in the Silverlon group received this double-tunneling technique (Table 1), conferring an additional baseline protective effect to this cohort. Similarly, mechanical driveline immobilization is critical; as demonstrated by Schachl et al. [14], optimal driveline anchoring prevents trauma at the DLES, thereby preserving the tissue-device interface and reducing DLI rates. All patients in our study received identical mechanical stabilization utilizing the Secutape anchoring device (TechniMed AG, Rorschach, Switzerland) anchoring device; thus, this intervention can be entirely excluded as a differential or confounding protective factor between the two groups. Beyond procedural and mechanical factors, long-term success depends heavily on standardized wound management, structured hygiene education, and intensive training for nursing staff, patients, and caregivers [11]. In our multivariate analysis (Table 2), no independent risk factors for DLI reached statistical significance. While this lack of predictive variables was fundamentally driven by the zero-event rate within the Silverlon cohort, it highlights a broader clinical reality: DLI mitigation relies on a multifactorial strategy rather than a single isolated intervention.

From a health economic perspective, the ability of silver-plated dressing to mitigate DLI and prevent subsequent adverse events—such as hospital readmissions or secondary wound therapies—offers significant potential to reduce healthcare costs. Hospital readmissions present a substantial financial burden, costing about $52.4 billion annually in the US, with approximately 25% classified as preventable [29, 30]. In this context, implementing silver-plated dressings was associated with an absolute 11% reduction in DLI rates and sustained one-year freedom from DLI, an outcome that directly correlates with decreased infection-related hospital readmissions [24].

### 4.1 | Limitations

Several limitations of this study warrant discussion. First, the single-center design and relatively small sample size, which features a predominantly male distribution, may limit the generalizability of the findings. Second, because evaluation was restricted exclusively to HM3 patients, these results may not be applicable to other LVAD systems. Third, due to missing photograph documentation for a subset of patients, DESTINE staging was applied retrospectively alongside the institutional wound manager based on clinical records, introducing potential staging variance. Fourth, 100% of the Silverlon group received the driveline double-tunneling technique, compared to 79.5% in the Usual Care group ($p=0.04$) favoring a potential baseline surgical discrepancy, although in the univariable model, it did not identify as an independent predictor. Fifth, the additional cushioning of the Silverlon dressing provides a pressure-stabilizing effect at the DLES, which may introduce minor confounding in the Silverlon group. Sixth, the retrospective, non-randomized, and exploratory character of this study renders it primarily hypothesis-generating. Finally, the lack of DLI events within the Silverlon cohort prevented the identification of independent predictors in a multivariate model, highlighting the need for larger, randomized multicenter trials to validate our results.

## 5 | Conclusion

Given the severe clinical burden of DLIs, integrating silver-plated dressings into standard LVAD care represents a safe and effective strategy. While DLI mitigation relies on a multifactorial bundle, the zero-event rate achieved in the Silverlon cohort underscores the dressing's critical additive value in enhancing wound healing and eliminating DLI incidence, though further prospective trials are needed to evaluate its long-term health-economic impact.

#### Author Contributions

**Barbara Veiter:** data curation, formal analysis, investigation, methodology, writing – original draft, writing – review and editing. **Martina Socha:** data curation, investigation, methodology, writing – review and editing. **Christiane Marko:** data curation, investigation, writing – review and editing. **Nesibe Seyda Colak:** data curation, investigation, writing – review and editing. **Alexandra Kuhn:** data curation, writing – review and editing. **Hebe Al Asadi:** data curation, investigation, writing – review and editing. **Roxana Moayedifar:** data curation, investigation, writing – review and editing. **Julia Riebandt:** data curation, investigation, writing – review and editing. **Daniel Zimpfer:** conceptualization, supervision, writing – review and editing. **Thomas Schlöglhofer:** conceptualization, data curation, formal analysis, investigation, methodology, software, visualization, writing – original draft, resources, supervision. All authors have read and agreed to the published version of the manuscript.

#### Acknowledgments

Open Access funding provided by Medizinische Universitat Wien.

#### Funding

This work was supported by Bravida Medical.

#### Disclosure

Christiane Marko speaker (Abbott Inc.). Julia Riebandt speaker (Abbott Inc. and J&J MedTech). Daniel Zimpfer proctor, speaker and advisor (Medtronic Inc., Edwards, Corzym, Abiomed, Abbott Inc., Berlin Heart and Atricure), research and travel grants (Medtronic Inc., Edwards,

Corzym, Abiomed, Abbott Inc., Berlin Heart and Atricure). Thomas Schlöglhofer consultant and advisor (Medtronic Inc., Abbott Inc., Berlin Heart, BiVACOR and CorWave), and research grants (BrioHealth Solutions, Bravida Medical, Abbott Inc., Berlin Heart, BiVACOR, CorWave, and J&J MedTech). All other authors have nothing to disclose.

### Conflicts of Interest

The authors declare no conflicts of interest.

### Data Availability Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

### References


1. A. M. Bernhardt, M. K. Kanwar, M. Kittleson, et al., "Net Prolongation of Life in Advanced Heart Failure: An Intentional Strategy of Durable LVAD Therapy Followed by Heart Transplantation," *Journal of Heart and Lung Transplantation* (2026), https://doi.org/10.1016/j.healun.2026.03.006.

2. A. Nayak, T. M. Cascino, E. M. DeFilippis, et al., "The Society of Thoracic Surgeons Intermacs 2025 Annual Report: Focus on Outcomes in Older Adults," *Annals of Thoracic Surgery* 121, no. 1 (2026): 15–38, https://doi.org/10.1016/j.athoracsur.2025.10.005.

3. A. S. Varshney, E. M. DeFilippis, J. A. Cowger, I. Netuka, S. P. Pinney, and M. M. Givertz, "Trends and Outcomes of Left Ventricular Assist Device Therapy: JACC Focus Seminar," *Journal of the American College of Cardiology* 79, no. 11 (2022): 1092–1107, https://doi.org/10.1016/j.jacc.2022.01.017.

4. J. A. Cowger, E. Molina, L. Deng, et al., "Defining Optimal Left Ventricular Assist Device Short-Term Outcomes May Provide Insight Into Programmatic Quality Assessment," *Journal of Heart and Lung Transplantation* 43, no. 11 (2024): 1777–1787, https://doi.org/10.1016/j.healun.2024.08.006.

5. S. Baudart and L. Klein, "A Silver Lining in the VAD Sky Impact of a Silver Dressing on LVAD Associated Driveline Infections," *JHLT Open* 13 (2026): 100556, https://doi.org/10.1016/j.jhlto.2026.100556.

6. D. Zimpfer, F. Gustafsson, E. Potapov, et al., "Two-Year Outcome After Implantation of a Full Magnetically Levitated Left Ventricular Assist Device: Results From the Elevate Registry," *European Heart Journal* 41, no. 39 (2020): 3801–3809, https://doi.org/10.1093/eurheartj/ehaa639.

7. S. Aslam, J. Cowger, P. Shah, et al., "The International Society for Heart and Lung Transplantation (ISHLT): 2024 Infection Definitions for Durable and Acute Mechanical Circulatory Support Devices," *Journal of Heart and Lung Transplantation* 43, no. 7 (2024): 1039–1050, https://doi.org/10.1016/j.healun.2024.03.004.

8. H. S. Lumish, B. Cagliostro, L. Braghieri, et al., "Driveline Infection in Left Ventricular Assist Device Patients: Effect of Standardized Protocols, Pathogen Type, and Treatment Strategy," *ASAIO Journal* 68, no. 12 (2022): 1450–1458, https://doi.org/10.1097/MAT.0000000000001690.

9. G. A. Hernandez, J. D. N. Breton, and S. V. Chaparro, "Driveline Infection in Ventricular Assist Devices and Its Implication in the Present Era of Destination Therapy," *Open Journal of Cardiovascular Surgery* 9 (2017): 1179065217714216, https://doi.org/10.1177/1179065217714216.

10. A. M. Leuck, "Left Ventricular Assist Device Driveline Infections: Recent Advances and Future Goals," *Journal of Thoracic Disease* 7, no. 12 (2015): 2151–2157, https://doi.org/10.3978/j.issn.2072-1439.2015.11.06.

11. A. M. Bernhardt, T. Schlöglhofer, V. Lauenroth, et al., "Prevention and Early Treatment of Driveline Infections in Ventricular Assist Device Patients—The DESTINE Staging Proposal and the First Standard of Care Protocol," *Journal of Critical Care* 56 (2020): 106–112, https://doi.org/10.1016/j.jcrc.2019.12.014.

12. G. Wasilewski, S. Wiśniowska-Śmiałek, I. Górkiewicz-Kot, et al., "Driveline Infection in Patients With Left Ventricular Assist Devices Implanted as Destination Therapy," *Transplantation Proceedings* 56, no. 4 (2024): 860–863, https://doi.org/10.1016/j.transproceed.2024.03.029.

13. M. Kranzl, M. Stoiber, A. K. Schaefer, et al., "Driveline Features as Risk Factor for Infection in Left Ventricular Assist Devices: Meta-Analysis and Experimental Tests," *Frontiers in Cardiovascular Medicine* 8 (2021): 784208, https://doi.org/10.3389/fcvm.2021.784208.

14. J. Schachl, M. Stoiber, M. Socha, et al., "Mechanical Characterization of Anchoring Devices for the Prevention of Driveline Infection in Left Ventricular Assist Device Patients," *ASAIO Journal* 70, no. 4 (2024): 249, https://doi.org/10.1097/MAT.0000000000002111.

15. Z. O. Koken, Y. C. Yalcin, D. van Netten, et al., "Driveline Exit-Site Care Protocols in Patients With Left Ventricular Assist Devices: A Systematic Review," *European Journal of Cardio-Thoracic Surgery* 60, no. 3 (2021): 506–515, https://doi.org/10.1093/ejcts/ezab195.

16. D. J. Barillo and D. E. Marx, "Silver in Medicine: A Brief History BC 335 to Present," *Burns* 40 (2014): S3–S8, https://doi.org/10.1016/j.burns.2014.09.009.

17. H. Al Asadi, M. Socha, C. Marko, et al., "Cold Atmospheric Plasma Therapy: An Innovative Approach to Treating Driveline Infections in Left Ventricular Assist Device Recipients," *Artificial Organs* 50, no. 6 (2026): 877–885, https://doi.org/10.1111/aor.70135.

18. T. Schlöglhofer, P. Michalovics, J. Riebandt, et al., "Left Ventricular Assist Device Driveline Infections in Three Contemporary Devices," *Artificial Organs* 45, no. 5 (2021): 464–472, https://doi.org/10.1111/aor.13843.

19. P. Angleitner, A. Matic, A. Kaider, et al., "Blood Stream Infection and Outcomes in Recipients of a Left Ventricular Assist Device," *European Journal of Cardio-Thoracic Surgery* 58 (2020): ezaa153, https://doi.org/10.1093/ejcts/ezaa153.

20. K. Liang, Y. Liu, and F. Jiang, "Analysis of Therapeutic Effect of Silver-Based Dressings on Chronic Wound Healing," *International Wound Journal* 21, no. 8 (2024): e70006, https://doi.org/10.1111/iwj.70006.

21. J. A. Cowger, S. Schettle, F. D. Pagani, et al., "Heterogeneity in HeartMate 3 Implanting Center Infection Management Reveals Opportunities for Quality Improvement and Best Practice Initiatives During Left Ventricular Assist Device Support," *Journal of Heart and Lung Transplantation* 45 (2025), https://doi.org/10.1016/j.healun.2025.07.024.

22. A. May, Z. Kopecki, B. Carney, and A. Cowin, "Antimicrobial Silver Dressings: A Review of Emerging Issues for Modern Wound Care," *ANZ Journal of Surgery* 92, no. 3 (2022): 379–384, https://doi.org/10.1111/ans.17382.

23. E. C. Abboud, J. C. Settle, T. B. Legare, J. E. Marcet, D. J. Barillo, and J. E. Sanchez, "Silver-Based Dressings for the Reduction of Surgical Site Infection: Review of Current Experience and Recommendation for Future Studies," *Burns* 40 (2014): S30–S39, https://doi.org/10.1016/j.burns.2014.09.011.

24. B. Cagliostro, A. P. Levin, J. Fried, et al., "Continuous-Flow Left Ventricular Assist Devices and Usefulness of a Standardized Strategy to Reduce Drive-Line Infections," *Journal of Heart and Lung Transplantation* 35, no. 1 (2016): 108–114, https://doi.org/10.1016/j.healun.2015.06.010.

25. P. R. More, S. Pandit, A. D. Filippis, G. Franci, I. Mijakovic, and M. Galdiero, "Silver Nanoparticles: Bactericidal and Mechanistic Approach Against Drug Resistant Pathogens," *Microorganisms* 11, no. 2 (2023): 369, https://doi.org/10.3390/microorganisms11020369.

26. E. Dube and G. E. Okuthe, "Silver Nanoparticle-Based Antimicrobial Coatings: Sustainable Strategies for Microbial Contamination Control," *Microbiology Research* 16, no. 6 (2025): 110, https://doi.org/10.3390/microbiolres16060110.

27. L. Wert, J. S. Hanke, G. Dogan, et al., "Reduction of Driveline Infections Through Doubled Driveline Tunneling of Left Ventricular Assist Devices—5-Year Follow-Up," *Journal of Thoracic Disease* 10 (2018): S1703–S1710, https://doi.org/10.21037/jtd.2018.03.127.

28. F. Fleissner, M. Avsar, D. Malehsa, M. Strueber, A. Haverich, and J. D. Schmitto, "Reduction of Driveline Infections Through Doubled Driveline Tunneling of Left Ventricular Assist Devices," *Artificial Organs* 37, no. 1 (2013): 102–107, https://doi.org/10.1111/aor.12036.

29. A. D. Auerbach, S. Kripalani, E. E. Vasilevskis, et al., "Preventability and Causes of Readmissions in a National Cohort of General Medicine Patients," *JAMA Internal Medicine* 176, no. 4 (2016): 484–493, https://doi.org/10.1001/jamainternmed.2015.7863.

30. T. K. Nuckols, E. Keeler, S. Morton, et al., "Economic Evaluation of Quality Improvement Interventions Designed to Prevent Hospital Readmission: A Systematic Review and Meta-Analysis," *JAMA Internal Medicine* 177, no. 7 (2017): 975–985, https://doi.org/10.1001/jamainternmed.2017.1136.

## Supporting Information

Additional supporting information can be found online in the Supporting Information section. **Figure S1:** Wound dressing change with Silverlon DESTINE stage 0. **Figure S2:** Freedom from NPWT therapy stratified by group (Silverlon 100% vs. Usual Care 97.4%; $p = 0.45$). NPWT, negative pressure wound therapy; POD, postoperative day. **Figure S3:** Freedom from hospital readmission stratified by group (Silverlon 100% vs. Usual Care 97.4%; $p = 0.45$). POD, postoperative day. **Table S1:** Univariable Cox regression analysis. BMI, body mass index; BTC, bridge to candidacy; BTT, bridge to transplant; CI, confidence interval; CMP, cardiomyopathy; DL, driveline; DT, destination therapy; ECMO, extracorporeal membrane oxygenation; FFUV, first follow-up visit. **Table S2:** Longitudinal analysis. BUN, blood urea nitrogen; CRP, C-reactive protein; DESTINE, Driveline Expert STagINg; DLI, driveline infection; FFUV, first follow-up visit; FUV, follow-up visit; gram-pos., gram-positive; gram-neg., gram-negative; NPWT, negative pressure wound therapy.