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A COMPREHENSIVE DIAGNOSTIC AND THERAPEUTIC STRATEGY FOR DRIVELINE INFECTIONS IN LONG-TERM MECHANICAL CIRCULATORY SUPPORT

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Objective: to evaluate the clinical efficacy of a comprehensive approach to the diagnosis and surgical treatment of driveline infections (DLIs) in patients with long-term mechanical circulatory support (MCS). **Materials and methods.** A single-center retrospective observational study was conducted at Shumakov National Medical Research Center of Transplantology and Artificial Organs. The analysis included 56 patients with implanted devices for long-term MCS of the left ventricle: AVK-N (2012–2018) – 17; Stream Cardio (2022–2025) – 32; HeartMate 3 (2022–2025) – 7 people. **Results.** DLIs were identified in 18 of 56 patients (32.1%) with long-term left ventricular MCS. In the group managed without the diagnostic and therapeutic DLI algorithm, infections occurred in 8 of 17 patients (47.1%), whereas in the group managed with the algorithm, DLIs were detected in 10 of 39 patients (25.6%). Most DLI episodes developed within the first six months after device implantation. Implementation of the diagnostic and treatment algorithm resulted in a reduction in relapse frequency in patients with extensive forms of DLI (from 2.25 to 1.17 episodes per patient; $p = 0.050$) and a significant decrease in the duration of hospitalization for both local and subcutaneous forms ($p = 0.022$ and $p = 0.014$, respectively). **Conclusion.** The use of the developed algorithm for the diagnosis and treatment of DLIs in patients receiving long-term MCS enabled a systematic approach to patient management, improved the effectiveness of local infection control, reduced hospital length of stay, and decreased the frequency of infectious complications.

Keywords: heart transplantation, long-term mechanical circulatory support, driveline-associated infections.

INTRODUCTION

Long-term MCS has become an essential component in the management of end-stage heart failure over recent decades, serving both as a bridge to transplantation and as destination therapy [1–3]. Advances in device technology, particularly the transition to continuous-flow systems, have significantly improved patient survival and quality of life [1, 2]. However, infectious complications – especially DLIs – remain among the leading causes of rehospitalization, sepsis, and mortality in patients with long-term implantable devices [4–8].

According to international registry data, the incidence of infections at the driveline exit site ranges from 15% to 40%, depending on device type and duration of support [1–3, 8–11]. Despite progress in antimicrobial coatings and advanced wound care strategies, DLIs continue to require a comprehensive management approach that includes early diagnosis, timely surgical debridement, and effective local infection control [1–3, 5, 8, 12]. Particular attention is paid to biofilm mechanisms of pathogen persistence, primarily *Staphylococcus aureus* and *S. epidermidis*, which complicate eradication and contribute to the recurrence of DLIs [6, 7, 13].

To date, there is no universally accepted protocol or standard of care for managing infectious complications in patients receiving long-term left ventricular assist device support. Therapeutic strategies vary depending on the site of infection, the causative pathogen, device design, and the experience of individual centers. This variability highlights the need for a structured, stepwise, and clinically tailored approach to the diagnosis and management of these complications.

This study presents the results of evaluating the clinical efficacy of a diagnostic and treatment algorithm for DLIs in patients with long-term MCS. The algorithm was developed based on institutional clinical experience and an analysis of treatment outcomes at Shumakov National Medical Research Center of Transplantology and Artificial Organs, and was compared with previously used conventional approaches.

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The study evaluated the incidence, clinical and anatomical characteristics, and outcomes of DLIs according to the management strategy employed. In addition, a comparative analysis was conducted of pathogen profiles, timing of infection onset, and duration of hospital stay.

MATERIALS AND METHODS

The study was conducted at Shumakov National Medical Research Center of Transplantology and Artificial Organs. A total of 56 patients were included in the analysis, comprising 53 men (94.6%) and 3 women (5.4%), aged 27–74 years (mean age 56.6 ± 11.5 years), all of whom had implanted long-term MCS devices. The distribution of devices was as follows: AVK-N (Russia) – 17 cases, Stream Cardio (Bio Soft, Russia) – 32 cases, and HeartMate 3 (Abbott, USA) – 7 cases, implanted between 2012 and 2025.

The etiology of end-stage chronic heart failure (CHF) was dilated cardiomyopathy in 26 patients (46.4%) and ischemic cardiomyopathy in 30 patients (53.6%). According to the New York Heart Association (NYHA) functional classification, the majority of patients were in Class III (40 patients, 71%), while Class IV was observed in 16 patients (29%).

The distribution of patients by INTERMACS profiles was as follows: Profile 1 – 5 patients (8.9%), Profile 2 – 14 (25.0%), Profile 3 – 13 (23.2%), Profile 4 – 17 (30.4%), and Profile 5 – 7 (12.5%).

Depending on the management strategy applied for DLIs, patients were divided into two groups. In the group managed without the use of a dedicated DLI diagnostic and treatment algorithm, DLIs were identified in 8 of 17 patients (47.1%). Among patients managed using the algorithm, DLIs were detected in 10 of 39 cases (25.6%).

The first group comprised patients treated using a conventional approach to the prevention and management of DLIs (n = 8). This strategy included routine dressing changes and local antiseptic therapy. Diagnosis was based primarily on clinical signs, such as erythema, edema, and discharge at the exit site. Microbiological cultures and instrumental investigations were performed only when clearly indicated. Empirical systemic antibiotic therapy was initiated and subsequently adjusted according to culture results.

In cases of disease progression, surgical intervention involved incision, extensive drainage, and open wound management, followed by elective closure upon healing. Elective local revision with removal of the felt sheath along the driveline, as well as standardized use of vacuum-assisted closure (VAC) therapy, was not part of this treatment approach.

The second group comprised 10 patients with DLIs who were managed according to a novel diagnostic and treatment algorithm developed at Shumakov National Medical Research Center of Transplantology and Artificial Organs.

In both cohorts, DLIs were classified based on the clinical and anatomical extent of the inflammatory process. Three categories were defined to standardize case description and enable comparative analysis. The stages of progression of driveline infection in long-term MCS are schematically illustrated in Fig. 1.

- **Group A** – localized inflammation confined to the driveline exit site, without extension into subcutaneous adipose tissue or involvement of adjacent structures.
- **Group B** – infection extending into the subcutaneous adipose tissue and tracking along the driveline to its bend at the level of the right hypochondrium (the so-called "critical point").
- **Group C** – advanced infection involving the pericardial cavity and/or the pump pocket, associated with a high risk of mediastinitis and systemic inflammatory response.

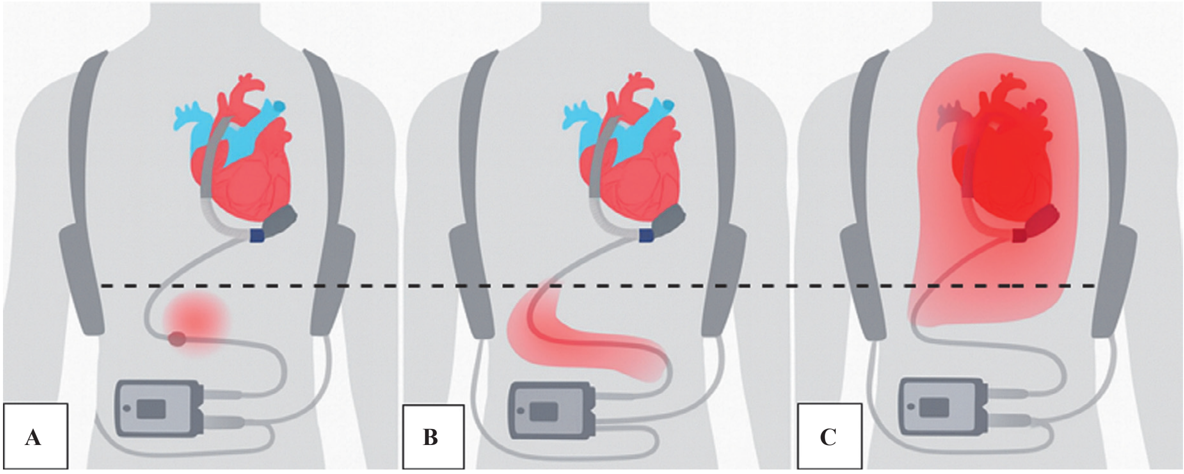

Fig. 1. Stages of progression of driveline infection in long-term mechanical circulatory support. (A) local infection; (B) subcutaneous spread; (C) deep infection with pericardial involvement. The dotted line indicates the "critical point" beyond which further spread of the infectious process occurs

Data were initially processed and tabulated using Microsoft Excel (MS Office Excel 2021), and statistical analysis was performed using StatTech v. 3.1.10 (StatTech LLC, Russia). Nonparametric methods were applied for the comparison of quantitative variables. Results were presented as median and interquartile range (Me [Q1; Q3]) and were analyzed using the Mann–Whitney U test and Pearson's chi-square test. Categorical variables were expressed as absolute and relative values (n, %) and were compared using Fisher's exact test. A p-value <0.05 was considered statistically significant.

RESULTS

The Developed Algorithm for the Diagnosis and Treatment of DLIs

Based on clinical experience and analysis of treatment outcomes at the Shumakov National Medical Research Center of Transplantology and Artificial Organs, a structured, step-by-step algorithm for the diagnosis and treatment of DLIs in patients with long-term MCS was developed (Fig. 2).

1. In the presence of pain, erythema, discharge, or fever, a comprehensive clinical evaluation of the driveline exit site is performed. This includes assessment of the extent and intensity of erythema, degree of tissue infiltration, presence of fluctuation, characteristics of the discharge (volume, consistency, and odor), condition of surrounding tissues, as well as the tension and fixation of the driveline. Rapid progression of erythema, the appearance of foul-smelling purulent discharge, fever >38.5 °C, or signs of systemic inflammatory response are considered indications for urgent hospitalization and immediate transition to the next stage of diagnostic evaluation.
2. If infection is suspected, an ultrasound (US) examination of the soft tissues along the driveline tunnel is performed to assess the depth and extent of the inflammatory process and to identify fluid collections or abscess cavities (Fig. 3).

   If there is suspicion of infection spreading along the driveline tunnel, a non-contrast CT scan of the chest is performed to evaluate the condition of the pericardium and chest wall (Fig. 4).

   The presence of fluid collections or gas inclusions along the course of the driveline or in proximity to the pericardium is regarded as an indication for urgent surgical debridement and consideration of emergency heart transplantation.
3. Microbiological diagnostics. If there are signs of inflammation (erythema, tissue infiltration, seropurulent discharge, tenderness, or bleeding), samples of local discharge are promptly obtained for microbiological culture. Additional swabs are taken from the skin surface, the driveline entry site, and the external sheath of the cable. Prior to initiating antibiotic therapy, blood samples are collected for culture, complete blood count, and biochemical analysis, including measurement of C-reactive protein and procalcitonin levels.

   Empirical and then targeted antibiotic therapy.

   Pending microbiological results, empirical antibiotic therapy is initiated using broad-spectrum agents targeting the most likely pathogens, primarily staphylococci, including Methicillin-resistant *Staphylococcus aureus*. Following identification of the causative microorganism, antimicrobial therapy is adjusted according to antibiotic susceptibility profiles. The duration and regimen of treatment are individualized based on the severity of the patient's condition and the extent of the infectious process. Subsequent management is determined by the clinical stage and progression of the infection.
4. Local antiseptic treatment.

   At any signs of local inflammation, daily antiseptic care of the driveline exit site is performed using 10% povidone-iodine or 0.05–0.5% chlorhexidine digluconate solutions. In cases of exudation, antiseptic-soaked dressings or local antiseptic baths may be applied. When the patient's condition stabilizes and discharge is planned, patients are instructed on appropriate self-care techniques. Dressing changes are typically performed at home every 3–4 days, following an individualized care plan established in consultation with the attending physician.
5. Surgical exploration and removal of the outer felt insulation sheath of the driveline (innovative approach).

   In cases of persistent inflammation or the formation of abscess cavities or sinus tracts, surgical intervention is indicated, including opening of the infected area, thorough debridement, and necrectomy.

   In all long-term MCS systems used in this study, the portion of the driveline located within the subcutaneous tissue is covered with a felt (textile) sheath, whereas the external segment is coated with a silicone layer. A unique technique implemented at our center involves selective removal of the outer felt sheath in the area of active infection.

   This approach is applied when infection spreads along the driveline tunnel. During surgical debridement, the felt sheath – which is poorly penetrated by antiseptics – is excised, exposing the underlying silicone surface, which can be more effectively disinfected.

   Removal of the felt sheath provides several advantages:

   1. reduction of the local bacterial load;
   2. prevention of capillary spread of infection along the sheath;
   3. improved efficacy of antiseptic treatment of the exposed driveline surface.

   The technique for removing the felt sheath is illustrated in Fig. 5.

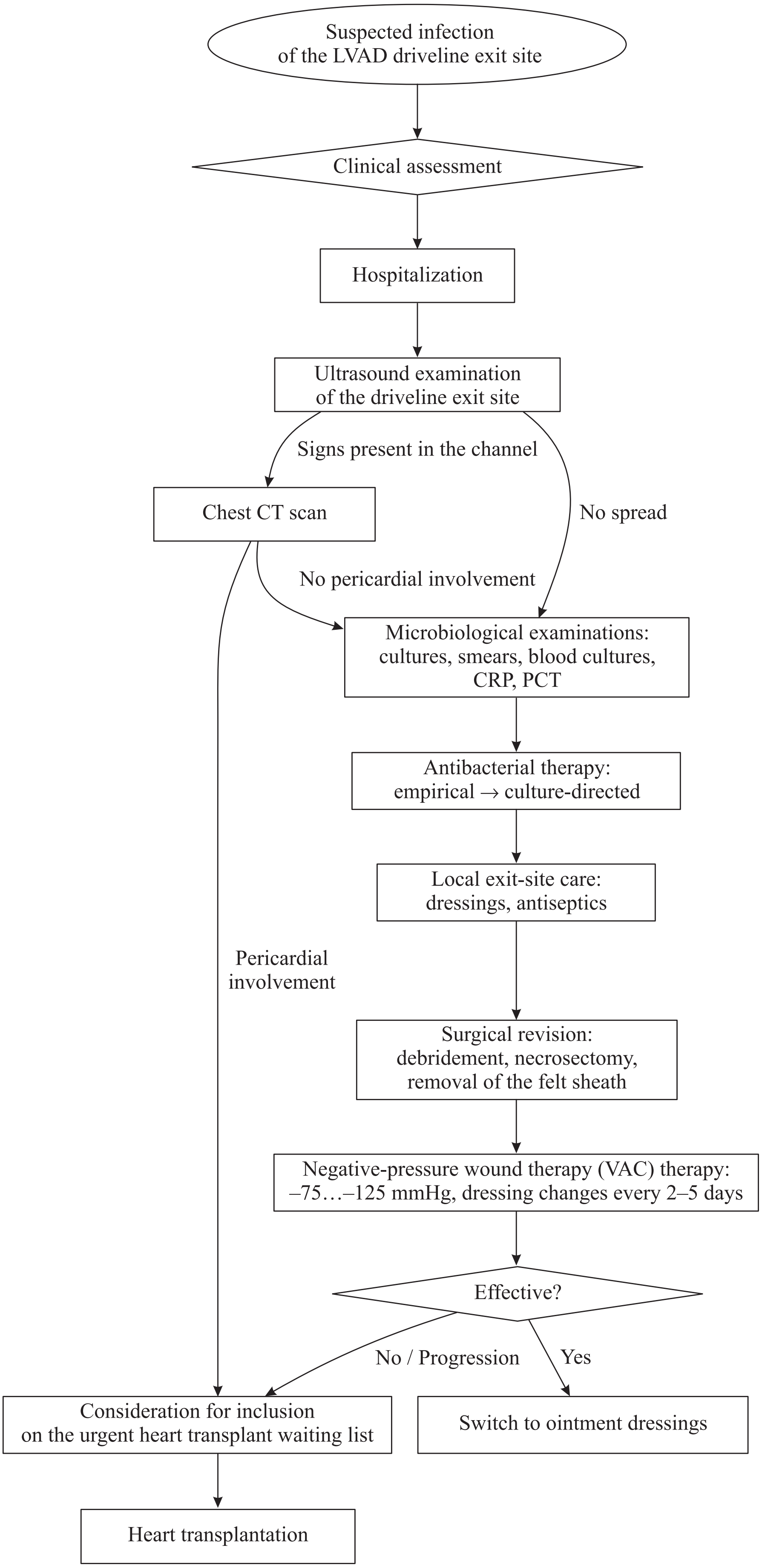

Fig. 2. Algorithm of diagnostic and therapeutic measures for driveline infection in patients with implanted long-term MCS devices

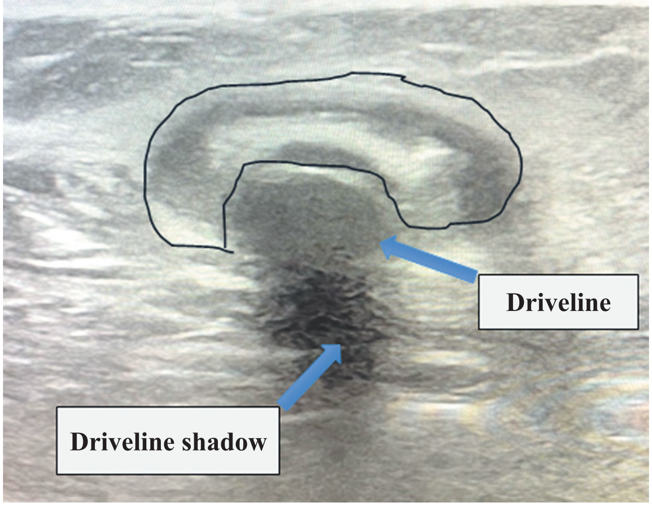

Fig. 3. Ultrasound image demonstrating localized inflammation in the subcutaneous adipose tissue along the driveline of a long-term MCS system. The highlighted area shows a rounded anechoic formation with irregular, indistinct margins and hyperechoic inclusions, with a tissue thickness of up to 4–5 cm, consistent with inflammatory changes and fluid accumulation

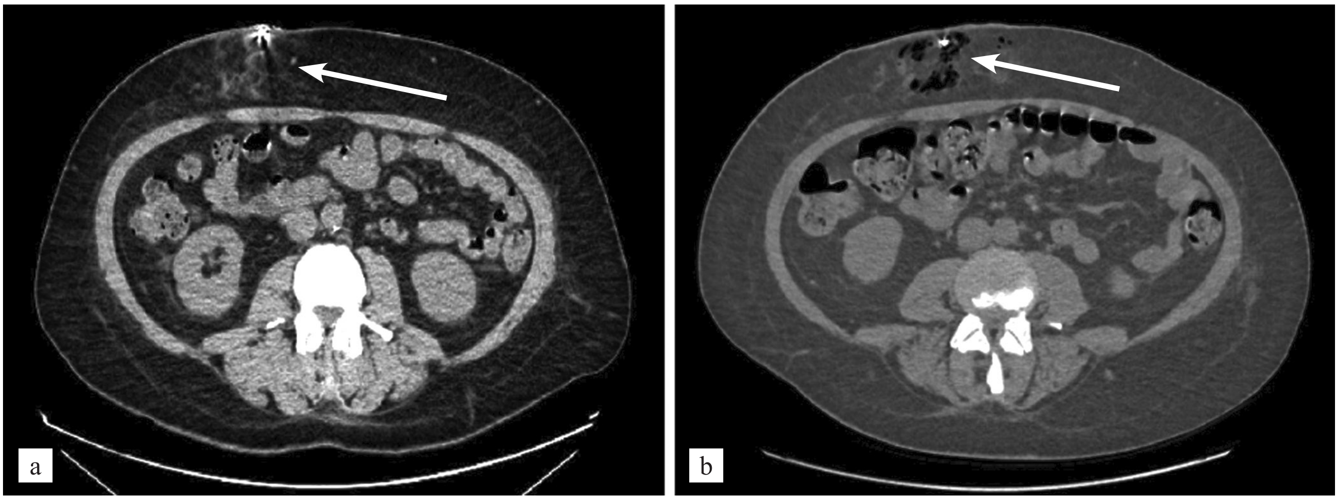

Fig. 4. CT image showing the spread of infection in the subcutaneous adipose tissue along the driveline of a long-term MCS system. (a) The arrow indicates an area of infiltration in the subcutaneous adipose tissue surrounding the driveline. (b) The arrow indicates gas accumulation within the subcutaneous adipose tissue around the driveline

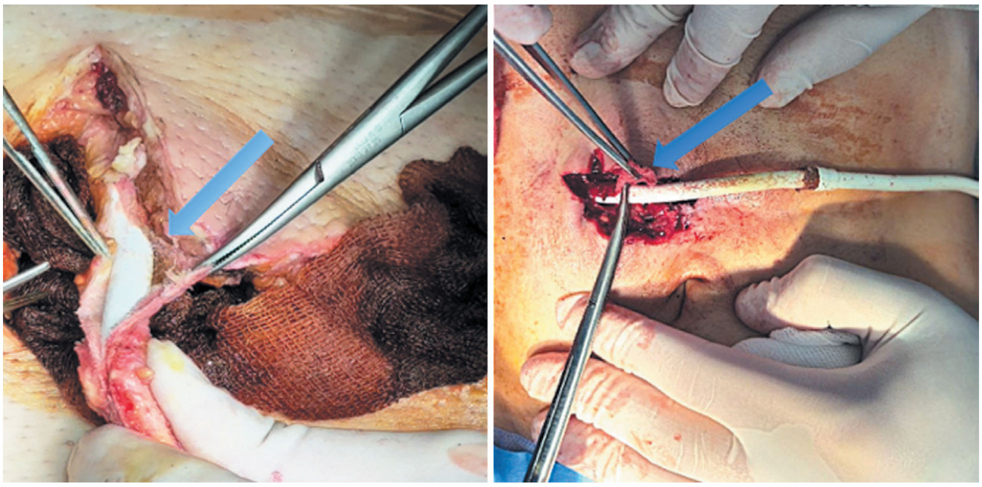

Fig. 5. Surgical removal of the outer felt sheath from the driveline in the area of active infection. Blue arrows indicate the felt covering of the driveline, beneath which lies the silicone layer

This approach enables sustained control of infection without the need for complete device explantation and, in stable cases, allows postponement or avoidance of transplantation. The technique was applied in 6 patients with infection extending into the soft tissues to a depth of at least 5 cm. In these cases, disease progression was effectively limited to the stage of surgical debridement with initial opening of the driveline tunnel to the same depth.

6. After opening the infected tract and performing thorough debridement with removal of necrotic tissue down to viable margins, a VAC system was applied to control infection and promote granulation tissue formation (Fig. 6). In the early postoperative phase, continuous negative pressure of approximately –100 to –125 mmHg was used (reduced to 75–100 mmHg in cases of pain or bleeding). Subsequently, an intermittent regimen was applied depending on patient tolerance. Dressings were changed every 48–72 hours in cases of active infection, and every 3–5 days during the stabilization phase. In cases of significant exudate or biofilm formation, intermittent irrigation with 0.9% NaCl or antiseptic solutions (according to institutional protocol) was performed, combined with cyclical aspiration and drainage as required. Efficacy is assessed based on clinical improvement (reduction in erythema/exudation, appearance of mature granulation tissue, and contraction of the wound edges), laboratory dynamics (decrease in C-reactive protein and procalcitonin levels, normalization of white blood cell count, negative or scant repeat cultures, negative blood cultures), and instrumental findings (disappearance of cavities/fluid/gas on ultrasound along the cable). Transition from VAC therapy to ointment-based dressings is indicated in cases of minimal exudate, absence of purulent discharge, fluctuation or odor; granulation tissue covering approximately 80–90% of the wound bed with a residual depth of less than 0.5–1 cm and no residual pockets; and microbiological findings showing negative or minimal growth without resistant strains, accompanied by sustained favorable clinical and laboratory trends.
7. If infection extends along the driveline tunnel toward the chest wall or pericardial region, the patient is placed on the emergency heart transplant waiting list. The region where the driveline bends near the right costal arch is considered a critical anatomical zone; if inflammation reaches this region, it is regarded as a high risk for mediastinal spread and constitutes an indication for transplantation (Fig. 1). This strategy is intended to prevent deep infectious complications, reduce the risk of vascular anastomotic erosion, and improve post-transplant outcomes.

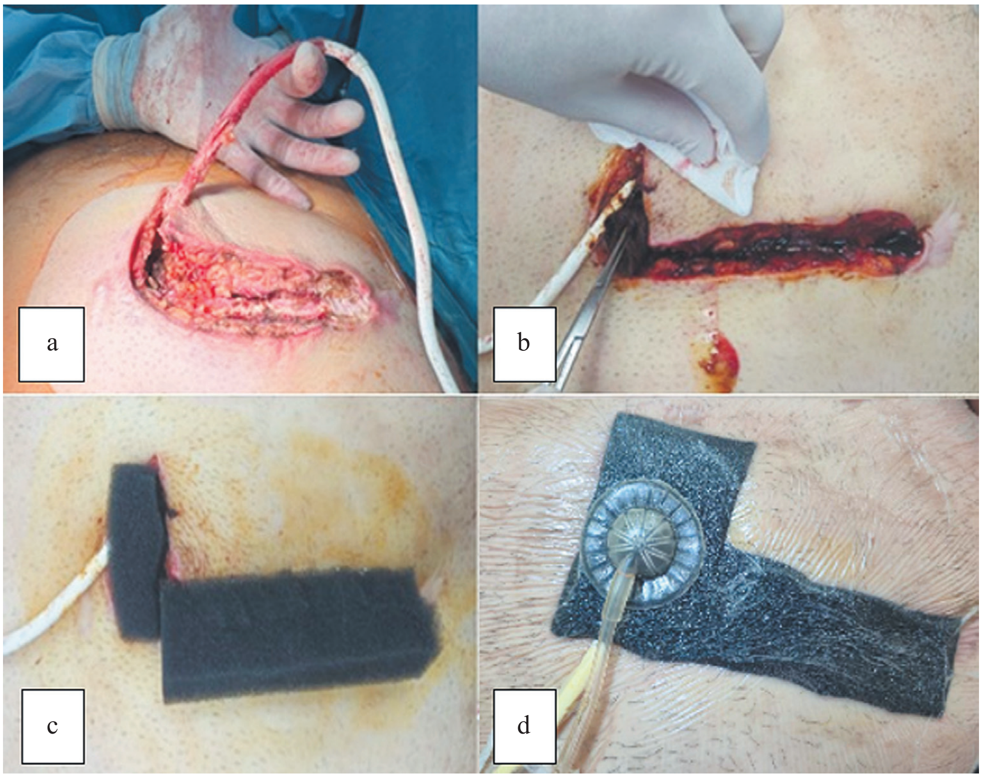

Fig. 6. Stages of surgical treatment of DLI spreading through the subcutaneous adipose tissue along the driveline. (a) Opening of the driveline tunnel with necrosectomy, debridement, and removal of the felt sheath; (b) Antiseptic treatment of the driveline bed; (c) Placement of the negative-pressure wound therapy (VAC) sponge in the driveline bed; (d) View of the functioning VAC system

Comparative evaluation of treatment efficacy in driveline-associated infections in patients on long-term MCS

A retrospective analysis demonstrated that, in the cohort managed without the DLI treatment algorithm (2010–2018), DLIs occurred in 8 patients (47.1% of all implantations). Initially, all cases corresponded to Group A (localized infection). However, in 4 patients, the infection progressed to Group B, and in 1 patient, it advanced to a deep infection involving the pump pocket and pericardial cavity (Group C), necessitating emergency heart transplantation (HT).

It is noteworthy that, in this cohort, the only contraindication to HT in 6 patients was severe pulmonary hypertension, while in the remaining cases the devices were implanted as a bridge to transplantation.

In the group managed using the diagnostic and treatment algorithm (2022–2025), the overall incidence of DLIs was 25.6% (10 of 39 patients). In all cases, the infection initially corresponded to Group A (localized inflammation at the driveline exit site). However, in a subset of patients, progression was observed with spread of infection along the driveline within the subcutaneous tissue to the level of its curvature in the right hypochondrium, corresponding to transition to Group B.

In three patients, the infectious process reached the so-called "critical point", necessitating urgent inclusion on the HT wait list. In one of these cases, the condition was further complicated by refractory right ventricular failure. In all three patients, severe diabetes mellitus represented an additional adverse factor contributing to the unfavorable clinical course.

The clinical characteristics of the DLI algorithm-treated cohort were influenced by the distribution of baseline contraindications to HT. Among all patients in this group, 25 (64.1%) were deemed ineligible for transplantation due to severe pulmonary hypertension, while additional contraindications included malignancy in 3 patients, multifocal atherosclerosis in 3 patients, and severe diabetes mellitus in 8 patients.

In the cohort in which the DLI treatment algorithm was applied, 10 cases of Group A infection were initially identified. In 6 patients, progression to Group B was observed, including individuals with diabetes mellitus. Importantly, in none of these cases did the infectious process advance beyond the "critical point". The combined use of mandatory imaging, targeted antimicrobial therapy, local removal of the felt driveline sheath, and VAC therapy enabled effective resolution of inflammation at stage B, thereby preventing further progression and eliminating the need for emergency transplantation.

Analysis of time to onset and duration of inpatient treatment for driveline-associated infections

The distribution of time to onset of DLIs in both the non-algorithm and algorithm cohorts is presented in Fig. 7. Despite differences between groups, the overall pattern demonstrated that in 77.8% of cases (14 of 18), DLIs developed within the first 180 days post-implantation (p = 0.62). In the cohort managed without the algorithm, the onset of DLIs ranged from 18 to 360 days after device implantation. Very early infections (<30 days post-implantation) were observed in 1 patient (12.5%).

DLIs were recorded in 3 patients (37.5%) between 31 and 90 days post-implantation, in 3 patients (37.5%) between 91 and 180 days, and in 1 patient (12.5%) between 181 and 360 days. Overall, in 87.5% of cases, DLIs occurred within the first 6 months after device implantation, indicating a pronounced vulnerability during the early postoperative period.

The occurrence of very early infections, as well as the high proportion of complications within the first 180 days, may be associated with device design characte-

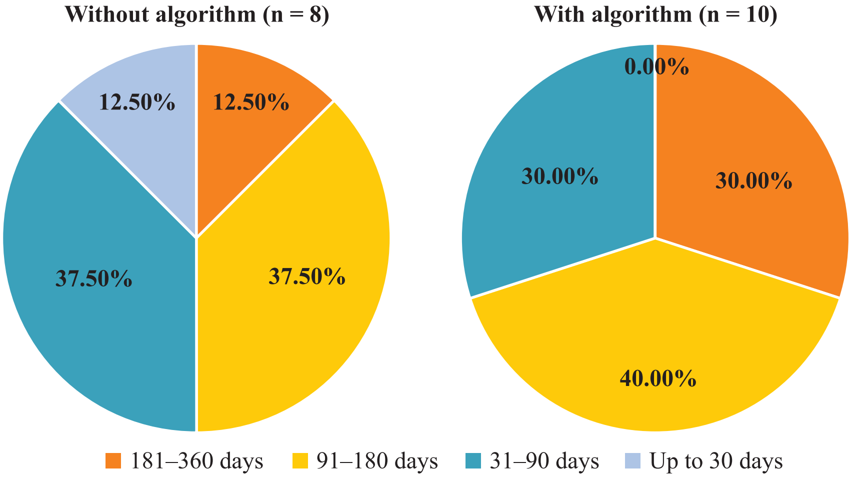

Fig. 7. Distribution of the timing of DLIs in patient cohorts managed with and without the developed diagnostic and treatment algorithm, expressed as a percentage of patients with DLIs

ristics, surgical implantation techniques, and the limited preventive strategies available during the study period.

In the cohort of patients managed using the algorithm, the time to onset of DLIs ranged from 31 to 360 days after implantation. No very early cases (<30 days) were observed. DLIs occurred in 3 patients (30%) within 31–90 days, in 4 patients (40%) within 91–180 days, and in 3 patients (30%) within 181–360 days. Overall, 70% of all episodes developed within the first 6 months after implantation, indicating that the risk of DLIs remains highest during the early postoperative period.

The absence of very early infections and the more uniform distribution of cases throughout the first year of follow-up may reflect improvements in surgical implantation techniques, as well as the implementation of the modified algorithm for prevention and management of DLIs.

A comparative analysis of the duration of hospital stay in patients with DLIs was performed across both cohorts and stratified according to the extent of the inflammatory process. Mean values and standard deviations were calculated for each subgroup. The results of this analysis are presented in Table 1.

In Group A, the mean duration of inpatient treatment in the cohort managed without the algorithm was 26.4 ± 8.1 days (n = 8), compared with 20.9 ± 6.5 days (n = 10) in the cohort where the algorithm was applied. The reduction in length of hospital stay with the use of the modified algorithm was statistically significant (p = 0.022).

At this stage, the infectious process is still limited in nature, and timely diagnosis, adequate antibiotic therapy, and dynamic monitoring play a leading role. Standardizing these stages within the algorithm contributed to a shorter treatment duration and reduced the likelihood of disease progression.

In Group B, a similar trend was observed. The mean duration of hospitalization in the cohort without the algorithm was 59.1 ± 9.6 days (n = 4), whereas in the cohort treated using the algorithm, it was significantly lower at 46.5 ± 10.9 days (n = 6), with statistically significant differences (p = 0.014).

It is important to note that in Group B – where the inflammatory process extends along the driveline within the subcutaneous tissue and approaches the "critical point" – the algorithm calls for early heart transplantation if this boundary is reached. In the present study, three patients underwent transplantation proactively, before progression beyond the "critical point". This strategy helps prevent further spread of infection to the pericardium or pump pocket, thereby reducing the need for multi-stage debridement and prolonged hospitalization.

In Group C, within the cohort managed without the algorithm, one patient had a prolonged hospital stay of 72 days due to a severe course of driveline infection. This case required extensive surgical intervention and ultimately led to urgent heart transplantation, prompted by a high risk of mortality associated with potential mediastinal spread of infection and systemic complications. In this clinical context, continuation of mechanical circulatory support was considered unsafe.

Notably, no patients progressed to Group C in the cohort managed with the algorithm. This is attributable to the implementation of an early transplant strategy at the Group B stage upon reaching the "critical point". Such an approach effectively interrupts disease progression and prevents transition to severe forms of infection.

Across all comparable subgroups, implementation of the modified algorithm was associated with a reduction in the duration of hospitalization; in Groups A and B, these differences reached statistical significance. As expected, progression of the infectious process from Group A to Group B was accompanied by an increase in length of hospital stay. However, patients managed with the algorithm demonstrated significantly shorter hospitalization compared to those treated without it.

The observed effect can be attributed to several key components of the algorithm: standardized early assessment of the extent of infection, timely surgical debridement combined with local removal of the felt driveline sheath and application of VAC therapy, as well as dynamic re-stratification of patients on the HT waiting list upon reaching the "critical point" in cases of unfavorable clinical progression.

Together, these measures not only help prevent progression to deep infection (Group C) but also contribute to a reduction in the overall resource intensity of treatment.

Table 1

Average length of hospital stay during the first year of follow-up

Subgroup	Without algorithm (mean ±; n)	With algorithm (mean ±; n)	Mann–Whitney U test (p)
A (initial)	26.4 ± 8.1 (n = 8)	20.9 ± 6.5 (n = 10)	0.022
B (transferred from A)	59.1 ± 9.6 (n = 4)	46.5 ± 10.9 (n = 6)	0.014
C (transferred from B)	72 (n = 1)	–	–

Note: Subgroup A includes all patients enrolled in the study at baseline (8 without algorithm, 10 with algorithm). Subgroups B and C reflect the dynamics of the disease and were formed from patients who were initially assigned to subgroup A.

Table 2

Comparative analysis of the proportion of patients experiencing relapses by group and cohort during the first year of follow-up

Group	Cohort	n	1 recurrence n (%)	2 recurrences n (%)	≥3 recurrences n (%)	p, Mann–Whitney U test
A	Without algorithm	8	0 (0.0%)	5 (62.5%)	3 (37.5%)	p = 0.331
	With algorithm	10	3 (30.0%)	4 (40.0%)	3 (30.0%)	
B	Without algorithm	4	0 (0.0%)	3 (75.0%)	1 (25.0%)	p = 0.05
	With algorithm	6	3 (50.0%)	2 (33.3%)	0 (0.0%)	

Analysis of the recurrence rate of driveline-associated infections

Despite the significant reduction in length of hospital stay achieved with the use of the DLI treatment algorithm, the decrease in infection recurrence rates was less pronounced. This finding can be partly explained by the characteristics of the study population. As noted earlier, a substantial proportion of patients in the algorithm-treated cohort had severe diabetes mellitus, which is an independent risk factor for infectious complications.

Consequently, although standardized diagnostic and therapeutic interventions contributed to shorter hospital stays, a tendency toward recurrent infection episodes persisted, particularly in Group A, while in Group B only a partial reduction in recurrence frequency was observed.

These findings prompted a separate, detailed analysis of recurrence rates in the compared cohorts, the results of which are presented in Table 2.

An analysis of the recurrence rate of DLIs during the first year of follow-up showed that, in Group A, the mean number of relapses per patient was 2.38 ± 0.52 in the cohort without the algorithm and 2.00 ± 0.82 in the cohort with the algorithm. The median value in both subgroups was identical (2), and no statistically significant differences were observed (p = 0.331). At the same time, both cohorts included patients with multiple recurrences (≥3 episodes: 3 of 8 *vs.* 3 of 10), indicating the presence of a subgroup with a persistent, relapsing course of infection, likely associated with significant comorbidities, including diabetes mellitus.

In Group B, the use of the algorithm was associated with a reduction in recurrence frequency: 2.25 ± 0.50 versus 1.17 ± 0.75 (median 2 *vs.* 1, respectively), with differences reaching borderline statistical significance (p = 0.05). The distribution pattern further supports the clinical relevance of this effect: in the algorithm-treated subgroup, one patient experienced no recurrences, and no cases with ≥3 episodes were observed, whereas such patterns were present in the cohort managed using the traditional approach.

In Group C, within the cohort without the algorithm, there was a single patient who did not experience any relapses.

DISCUSSION

The results of this study confirm that DLIs are one of the most common and clinically significant complications in patients receiving long-term MCS. The observed incidence of 32.1% is consistent with findings from both national and international registries, where reported rates range from 15% to 40% [7–9, 11, 15].

The first six months after device implantation emerged as the most vulnerable period for infection development. This likely reflects the phase during which the driveline exit tract is still forming and surrounding soft tissues are adapting to the presence of a foreign surface.

Localized infections were encountered more frequently than disseminated forms. However, it is the disseminated ones that largely determined clinical severity and the need for repeated surgical interventions.

A key determinant of treatment outcomes in this study was the implementation of a structured diagnostic and therapeutic algorithm for DLIs. The use of a comprehensive protocol – incorporating imaging modalities (ultrasound and CT), microbiological confirmation, targeted antibiotic therapy, and standardized surgical debridement – substantially improved control of the infectious process.

A particularly important component of the algorithm was the removal of the driveline's felt sheath when involved in the inflammatory process. This intervention facilitates elimination of biofilm and enables more effective and complete wound debridement.

In addition, the application of VAC therapy played a role in accelerating wound debridement and promoting the transition from the inflammatory to the reparative phase. This was reflected in shorter healing times and reduced hospital stays.

The practical significance of the proposed algorithm lies in reducing treatment duration for localized inflammation confined to the driveline exit site, decreases the frequency of recurrences, and prevents progression to deep, life-threatening forms involving the pericardial cavity and/or pump pocket, including through early heart transplantation, in cases of inflammation spreading to the subcutaneous fatty tissue and progressing along the driveline to its turn in the subcutaneous fatty tissue at the level of the right hypochondrium.

CONCLUSIONS

The developed algorithm for the diagnosis and surgical management of DLIs demonstrates clear clinical benefits. Its implementation is associated with reduced recurrence rates, shorter hospital stays, and a decreased need for repeated surgical debridement.

A comprehensive approach to the diagnosis and treatment of DLIs improves the effectiveness of local infection control and can be considered the optimal management strategy for patients on prolonged MCS.

The authors declare no conflict of interest.

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