DOI: 10.1111/jocs.14778

CASE REPORT

JOURNAL OF CARDIAC SURGERY WILEY

Absorbable antibiotic beads as an adjuvant therapy in treating ventricular assist devices driveline infection: A case report

Osama Haddad MD | Anthony N. Pham MS | Mathew Thomas MD | Mojahid Ali MD | Basar Sareyyupoglu MD | Magdy M. El-Sayed Ahmed MD | Si M. Pham MD

Department of Cardiothoracic Surgery, Mayo Clinic, Jacksonville, Florida

Correspondence
Si M. Pham, MD, 4500 San Pablo Rd S, Jacksonville, FL 32224.
Email: pham.si@mayo.edu

Abstract

Background: Ventricular assist devices driveline infections are common, recalcitrant, and carry high morbidity and mortality. Herein, we reported a patient with driveline infection that was successfully treated with a combination of systemic antibiotics, surgical debridement, and instillation of absorbable antibiotic beads to the wound bed.

Methods and Results: A 39-year-old man with nonischemic cardiomyopathy underwent insertion of a continuous flow left ventricular assist device. Four years postoperatively, the patient presented with clinical, laboratory, and radiologic signs of driveline tract infection. He underwent extensive surgical debridement, installation of absorbable antibiotic beads that consisted of calcium sulfate, vancomycin, and tobramycin, into the wound bed, and systemic antibiotics. The patient was free of infection 9 month postoperatively.

Conclusion: Absorbable calcium sulfate antibiotic beads may serve as a beneficial adjunct to surgical debridement and systemic antibiotics for the treatment of ventricular assist device driveline infection, and merit further investigation.

KEYWORDS

antibiotic beads, driveline infection, VADs

1 | INTRODUCTION

Ventricular assist devices (VADs) are essential in the management of patients with advanced heart failure as they prolong survival and improve quality of life.[1] Infection emerges as a major complication due to the need for an external driveline that tunnels out through a skin opening. In addition, infection risk is increased by the recent trend towards longer duration of mechanical circulatory support before transplant or as a destination therapy. VAD-related infections occur in 25% to 28% of continuous flow devices, with driveline infections (DLI) being the most common, occurring in up to 19% of all patients with VAD.[2,3] The most common organisms are Gram-positive cocci (44.8%) and Gram-negative rods (24.1%).[4] Patients with VAD DLI usually develop systemic symptoms such as fever, leukocytosis, subcutaneous induration, and purulent discharge from the exit site of the driveline.[5] Ultrasound or Computed Tomography (CT) in combination with fluid drainage and tissue cultures are used to localize fluid collection around the driveline and identify the infective organism.[5] Treatment usually includes a combination of prolonged course of antibiotics with surgical debridement, driveline exit site relocation, muscle flap coverage, or rarely device exchange. However, the infection is recalcitrant with an overall recurrence rate of about 50%.[6]

Herein, we report a case of successfully treated VAD DLI using a combination of systemic antibiotics, surgical debridement, driveline relocation, and antibiotic-loaded calcium sulfate (CS) absorbable beads (STIMULAN Rapid Cure; Biocomposites Inc, Wilmington, NC).

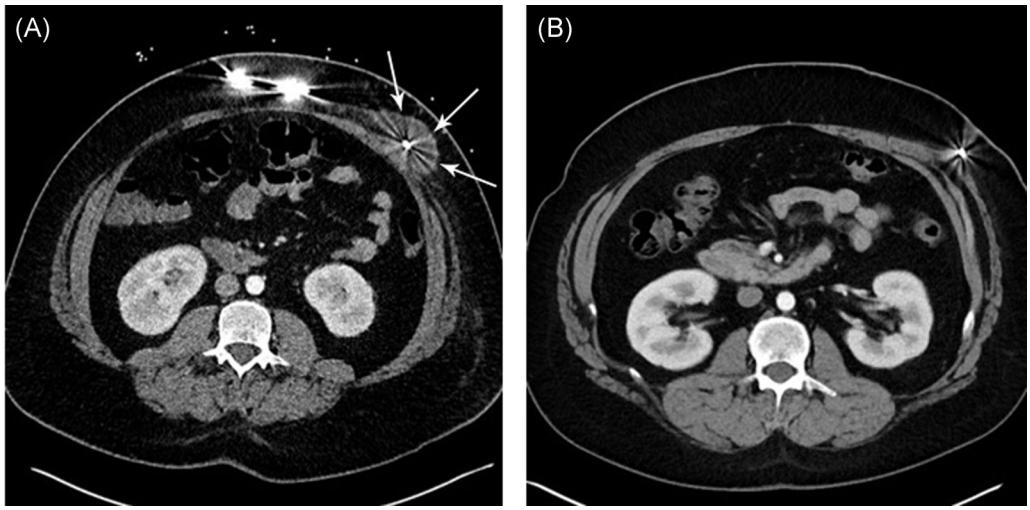

FIGURE 1 Computerized tomograms of the driveline tract 2 days before (A) and 2 months after (B) debridement. Fluid collection is noted around the driveline (arrows) before (A) but not after surgery (B)

2 | MATERIAL AND METHODS

The institution review board granted a waiver for this case report on 14 May 2020. A 39-years-old male diagnosed with nonischemic cardiomyopathy underwent an uneventful implantation of HeartWare HVAD (Medtronic Inc, Minneapolis, MN) left VAD in July 2015. Thereafter, the patient was admitted to the hospital twice, in October 2015 and February 2016, due to fever of unknown origin and hypotension, with negative blood and no clinical or radiologic signs of pump or driveline-related infection. Patient was managed with broad spectrum intravenous (IV) antibiotics (vancomycin, piperacillin, and tazobactam) and IV fluids. The patient showed a good response to treatment was discharged home without antibiotic suppression therapy.

In August 2019, the patient was readmitted for fever, chills and lethargy. He had severe tenderness along the driveline tract accompanied by drainage of serosanguinous fluid at the exit site. The patient had leukocytosis with a white blood count of 29, 300 cells/μL. A CT scan of the chest and abdomen showed a fluid collection tracking along the driveline in subcutaneous tissue consistent with an abscess (Figure 1A); blood cultures were negative for bacteria or

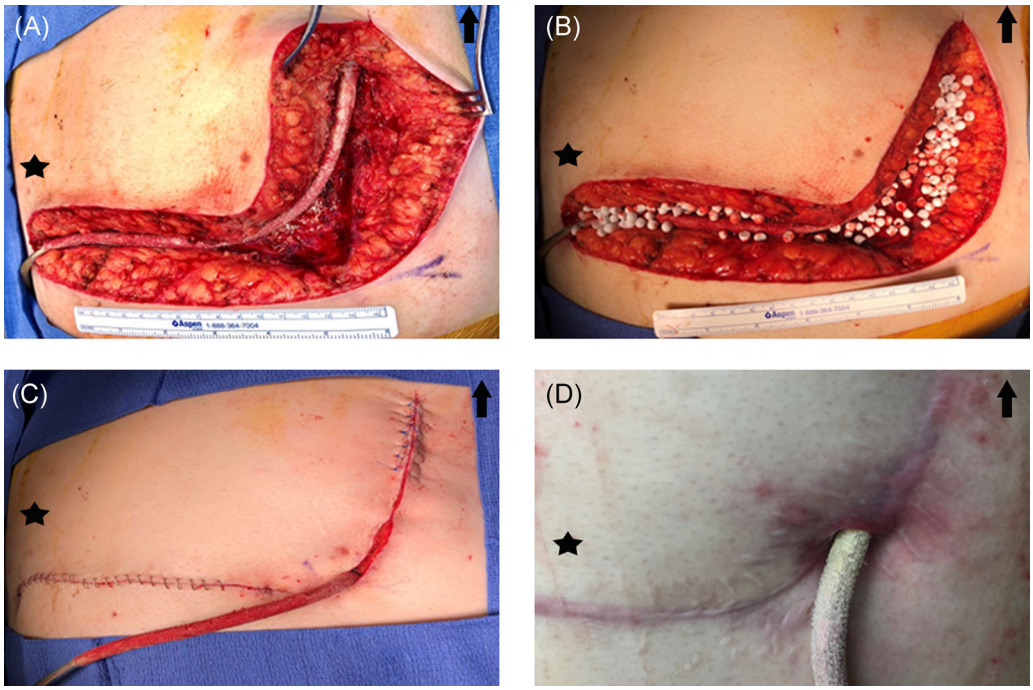

FIGURE 2 Intra- and postoperative photographs of the driveline site; arrows and stars point to patient's head and right, respectively. Wound beds without (A) and with antibiotic beads (B); incisions immediately (C) and 9 month (D) after surgery. The exit site of the driveline was moved to a new location to allow debridement and closure of the old site

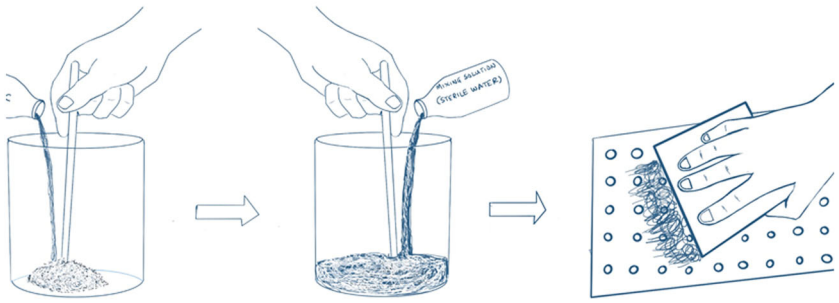

FIGURE 3 Diagram illustrating steps in preparing the calcium sulfate antibiotic beads. A, mixing antibiotic powder with STIMULAN Rapid Cure powder; B, adding sterile water or antibiotic solution to create a paste; C, spreading the paste to bead mat to create beads (adapted from the STIMULAN Rapid Cure package of insert)

fungi. The patient was started on broad spectrum antibiotics and underwent extensive debridement and unroofing of the driveline tract (Figure 2A). In addition, absorbable antibiotic beads, which consisted of vancomycin, tobramycin and CS (10 mL of STIMULAN Rapid Cure was mixed with 1 g of vancomycin, 240 mg of tobramycin; Figure 3), were spread along the entire debrided wound bed and the wound was closed by primary intention with relocation of the driveline exit site (Figure 2B,C). Tissue cultures grew oxacillin susceptible *Staphylococcus aureus*. The patient was treated with a 6-week course of IV cephazolin, followed by chronic suppression therapy with oral cefadroxil.

3 | RESULTS

Two months after surgery a CT scan of the chest and abdomen showed no fluid collection around the driveline tract (Figure 1B). At the time of this report (9 months postoperatively) the patient was doing well with no signs of DLI and the wound was well healed (Figure 2D).

4 | DISCUSSION

DLIs usually present more than 30 days after VAD insertion with an incidence of about 19%, and cause significant morbidity including repeated hospitalization, need for surgical intervention, prolonged antibiotic treatment, delay in transplantation, and increased risk of stroke and death.[3,7] Long duration of VAD support, trauma to the driveline, other comorbidities, and immunocompromised state in heart failure patients are major contributing factors. In addition, the driveline, which acts as a foreign body, allows formation of bacterial biofilms on its surface that renders the host immune response ineffective and impair the penetration of antibiotics.[8] All these factors explain the high recurrence rate, up to 50%, of DLIs.[6]

Treatment of DLIs usually involves a combination of IV antibiotics, surgical debridement, utilization of negative pressure wound therapy, muscle flap coverage, or in cases with extension to the pump pocket, a pump exchange. In patients who are candidates for heart transplant, VAD removal and heart transplant is the best option.

Local delivery of antibiotics to the wound bed is widely used in orthopedic and other surgical specialties, as this allows for delivery of higher local antibiotic concentrations without subjecting the host to systemic side effects. In cardiovascular surgery, various local antibiotic delivery methods are used, such as antibiotic irrigation, antibiotic paste application over sternal edges or direct antibiotic powder placement over vascular grafts, and wound beds.[9,10] Kretlow et al[11] described the use of nonabsorbable antibiotic beads (polymethylmethacrylate [PMMA]) in treating severe VAD pocket and DLIs with 65% of patients had successful results.

In our patient, we mixed CS (STIMULAN Rapid Cure), an absorbable bone void filler, with antibiotics and casted into small beads to place in the wound bed as an adjunct to surgical debridement. CS beads have multiple advantages over the PMMA beads.[12] First, the PMMA beads require a high curing temperature (93°C), therefore, only heat stable antibiotics, such as vancomycin or tobramycin, can be used, on the other hand, CS beads can be cured at room temperature, this allow for tailoring of the antibiotic mixture according to the infecting organism. Second, in addition for displaying variable elution kinetics, PMMA beads also serve as a nidus for infection, therefore, require another surgical procedure for replacement or removal.[11] In comparison, CS beads show more stable eluting properties over a wide range of antibiotics and are completely biodegradable, thus exchange is not required. Finally, CS beads showed higher antimicrobial and antibiofilm efficacy relative to that of PMMA beads.[12]

5 | CONCLUSION

VAD DLIs are recalcitrant and carry high morbidities. Absorbable CS antibiotic impregnated beads with their local sustained release kinetics, may serve as a beneficial adjunct to surgical debridement and systemic antibiotics, and merit further investigation.

ACKNOWLEDGMENT
The study was not financially supported.

CONFLICT OF INTERESTS
All the authors declare that there are no conflict of interests.

AUTHOR CONTRIBUTIONS
Concept/design: SMP and MT. Data collection, analysis, and interpretation: ANP, MA, OH, and SMP. Drafting the article: OH, ANP,

and MA. Critical revision of article: SMP, MT, ME-SA, and BS. Approval of article: All authors.

ORCID

Osama Haddad http://orcid.org/0000-0001-6308-6372
Anthony N. Pham http://orcid.org/0000-0002-5496-0301
Si M. Pham http://orcid.org/0000-0001-7396-8344

REFERENCES

1. MacIver J, Ross HJ. Quality of life and left ventricular assist device support. *Circ J*. 2012;126:866-874.
2. Kormos RL, Cowger J, Pagani FD, et al. The Society of Thoracic Surgeons Intermacs database annual report: evolving indications, outcomes, and scientific partnerships. *J Heart Lung Transplant*. 2019;38:114-126.
3. Goldstein DJ, Naftel D, Holman W, et al. Continuous-flow devices and percutaneous site infections: clinical outcomes. *J Heart Lung Transplant*. 2012;31:1151-1157.
4. Nienaber JJ, Kusne S, Riaz T, et al. Clinical manifestations and management of left ventricular assist device-associated infections. *Clin Infect Dis*. 2013;57:1438-1448.
5. Trachtenberg BH, Cordero-Reyes A, Elias B, Loebe M. A review of infections in patients with left ventricular assist devices: prevention, diagnosis and management. *Methodist Debakey Cardiovasc J*. 2015;11:28-32.
6. Vandersmissen K, Roppe M, Vissers S, Droogne W, Jacobs S, Meyns B. Driveline infections after LVAD implantation. *J Heart Lung Transplant*. 2020;39:S487. https://doi.org/10.1016/j.healun.2020.01.055
7. Gordon SM, Schmitt SK, Jacobs M, et al. Nosocomial bloodstream infections in patients with implantable left ventricular assist devices. *Ann Thorac Surg*. 2001;72:725-730.
8. Flemming H-C, Wingender J. The biofilm matrix. *Nat Rev Microbiol*. 2010;8:623-633.
9. Engelman R, Shahian D, Shemin R, et al. The Society of Thoracic Surgeons practice guideline series: antibiotic prophylaxis in cardiac surgery, part II: antibiotic choice. *Ann Thorac Surg*. 2007;83(4):1569-1576.
10. Lazar HL, Salm TV, Engelman R, Orgill D, Gordon S. Prevention and management of sternal wound infections. *J Thorac Cardiovasc Surg*. 2016;152(4):96297-2.
11. Kretlow JD, Brown RH, Wolfswinkel EM, et al. Salvage of infected left ventricular assist device with antibiotic beads. *Plast Reconstr Surg*. 2014;133:28e-38e.
12. Howlin RP, Brayford MJ, Webb JS, Cooper JJ, Aiken SS, Stoodley P. Antibiotic-loaded synthetic calcium sulfate beads for prevention of bacterial colonization and biofilm formation in periprosthetic infections. *Antimicrob Agents Chemother*. 2015;59:111-120.

How to cite this article: Haddad O, Pham AN, Thomas M, et al. Absorbable antibiotic beads as an adjuvant therapy in treating ventricular assist devices driveline infection: A case report. *J Card Surg*. 2020;1–4.
https://doi.org/10.1111/jocs.14778