Antibiotic Bead Therapy for Implantable Left Ventricular Device Pocket Infection

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Abstract

Infectious complications of left ventricular assist devices (LVAD) are associated with increases in morbidity, mortality, and hospital costs. Traditional treatment options include intravenous antibiotics, operative debridement, and pump exchange. Herein, we report the case of a 70-year-old female who developed a LVAD pocket infection two weeks after implantation and was successfully treated with antibiotic beads within the LVAD pocket, after the failure of traditional therapies. Antibiotic beads may be a useful adjunct in the treatment and salvage of an infected LVAD.

Keywords — ventricular assist device, infection, antibiotics.

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I. INTRODUCTION

Despite the advances in the design of LVADs, infectious complications remain an inherent and serious risk to both patients and the healthcare system [1, 2, 3]. To date, there is no well-defined guideline in the management of such infections. The traditional treatment options of intravenous antibiotics, operative washout and debridement, and “re-pocketing” the device are not always successful. Herein, we present the case of a patient with a LVAD pocket infection successfully salvaged with antibiotic beads, after the failure of traditional treatments.

II. OUR EXPERIENCE

A 70-year-old female with a ten-year history of chemotherapy-induced non-ischemic cardiomyopathy presented with progressively worsening symptoms and cardiac functions. After thorough evaluation, she was deemed an appropriate candidate for LVAD destination therapy. Informed consent was obtained and a HeartMate II (Thoratec, Pleasanton, CA) was implanted uneventfully. Two weeks after the procedure, the patient developed symptomatic pericardial and left pleural effusions, which were managed with percutaneous drainage. Fluid cultures from both sites grew Proteus mirabilis and sensitivity-targeted intravenous antibiotic therapy was initiated. A week later, after the removal of both drains, the patient developed a recurrent pericardial effusion. This was drained in the operating room, with purulent fluid evacuated from the pericardial space and LVAD pocket. The space was irrigated with antibiotic solution and a vacuum assisted closure (VAC) negative pressure wound therapy system (KCI, San Antonio, Texas) was applied. Over the course of the next few weeks, the patient returned to the operating room multiple times for washout of the LVAD pocket and exposed device using antibiotic irrigation. Informed consent was obtained prior to each procedure. Despite these efforts, fluid culture from the LVAD pocket was persistently positive for Proteus mirabilis. At this point, salvage therapy was initiated considering the risk of pump-housing infection. Tobramycin powder was mixed with polymethylmethacrylate (PMMA), strung on a prolene suture (Figure 1) and placed throughout the pocket to cover the LVAD device (Figure 2). A VAC was re-applied over top the antibiotics beads. Subsequent VAC changes were completed three times per week at the bedside while the antibiotic beads were kept in the pocket. Serum tobramycin levels were checked weekly to ensure that systemic levels did not become toxic to the patient. The patient was eventually discharged to a sub-acute rehabilitation facility with combined VAC therapy and intravenous antibiotics. Over the next three months, with improvement in the patient’s general and nutritional condition, the LVAD pocket infection was cleared, as confirmed by negative wound cultures.

Fig. 1. Tobramycin beads strung on a prolene suture.
Fig. 2. LVAD device is exposed due to pocket infection. Antibiotic beads are seen surrounding the LVAD device.

She returned to operating room three months after the initial operation for definitive flap coverage. All antibiotic beads were removed, the pocket was irrigated with antibiotic solution, tissue was debrided, and an omental pedicle flap was used for coverage the device and pocket. The patient did well post-operatively without further infectious complications and is currently doing well 36 months out from the initial operation.

III. DISCUSSION

Infectious complications are an inherent risk in implantable devices, such as LVAD. These complications may include driveline infections, pump-pocket infections, or LVAD-associated endocarditis leading to bacteremia and sepsis [1]. LVAD-associated infections are obviously a driving force for increased morbidity, mortality, and hospital costs [2]. Oz et al predicted the cost of hospitalization for LVAD implantation to double in the setting of pump housing infection and increase fivefold when sepsis develops [3].

To date, there is no well-accepted guideline in the management of LVAD housing infection. Commonly used therapies include intravenous antibiotics, operative irrigation and debridement, and pump relocation or exchange. Antibiotic bead therapy is well described in the orthopedic literature for the treatment of chronic osteomyelitis and is often utilized in the salvage of infected hardware [4, 5]. PMMA is a commonly used bone cement formed by an exothermic polymerization reaction between a powdered polymer and a liquid monomer [5,6]. Powdered antibiotic is mixed and suspended in the cement and gradually eluted into tissues over the course of weeks or months [6].

The choice of antibiotic must be heat-stable and hydrophilic (i.e. gentamicin, tobramycin, and vancomycin) [5]. In the event of antibiotic resistance and incompatibility with PMMA, bone graft substitutes have included calcium sulfate and fibrin sealant [5].

With the exception of select case reports and small case series, there have been no large studies evaluating the use of antibiotic-impregnated beads in cardiac surgery. McKellar et al. was among the first to describe the use of antibiotic-impregnated PMMA beads to control a pump infection [7]. Tobramycin, vancomycin, and PMMA powders were mixed into cement, placed as beads onto stainless steel wire, and packed around the infected device. These were removed at the time of cardiac transplantation. The largest study to date by Kretlow et al. studied twenty-six patients who were treated for LVAD-related infections using antibiotic-impregnated PMMA beads, calcium sulfate beads, or fibrin sealant. After an average of 2.1 weekly or bi-weekly bead exchanges, 65.4% of infections were cleared with a recurrence rate of 17.6% [8].

In our patient, traditional therapies (antibiotics and debridement) were initiated at the time of LVAD pocket infection. After the failure of both intravenous antibiotics and operative irrigation, a novel approach was utilized. Antibiotic beads allowed us to obtain high concentrations of antibiotic locally, while avoiding systemic complications. The beads were left in place over the course of several VAC changes until adequate source control was maintained, as confirmed by negative wound cultures. In addition, we elected for delayed omental flap closure due to the risk of flap failure in the setting of uncontrolled infection. This ultimately allowed us to preserve the original LVAD, presumably resulting in decreased risk, morbidity, and cost to the patient.

Although our experience with antibiotic beads was a positive one, more data is needed before a strong conclusion and recommendation can be made. Our study is limited in that it reports only a single case. The largest study to date in cardiac patients evaluated twenty-six patients. It would be prudent to establish a multi-center study for stronger evidence and conclusions regarding the efficacy and impact on morbidity, mortality, and hospital costs, although it is difficult to do. Additionally, our study evaluated the response of a single pathogen, Proteus mirabilis, to tobramycin impregnated PMMA beads. Different pathogens and antibiotic resistance patterns may preclude the use of PMMA beads and warrant alternative treatment modalities.

Given these data, antibiotic bead therapy may serve as an adjunct to the established use of systemic antibiotics, surgical debridement, and pump relocation.

REFERENCES