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Left ventricular assist device driveline infection and the frequency of dressing change in hospitalized patients

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ABSTRACT

Objectives: To determine if driveline infection is related to dressing change frequency in hospitalized adult patients with newly implanted left ventricular assist devices (LVAD).
Background: Guidelines do not exist for the frequency of driveline exit-site dressing change in hospitalized patients resulting in wide variation in practice.
Methods: A retrospective chart review was conducted on 68 patients implanted with a HeartMate II® LVAD between August 2008 and September 2013 at an urban medical center.
Results: No driveline infections were found. Frequency of the driveline dressing change varied from daily, three times a week, and weekly. The daily dressing change group was younger in age compared to the weekly group ($p = 0.005$) and three times a week group ($p = 0.001$). No other differences were found.
Conclusion: Driveline infections do not appear to be related to the frequency of dressing change in this population. Our data and other studies on this topic thus far are too limited to draw definitive conclusions about optimal frequency of dressing change for infection prevention.

Introduction

Heart failure affects more than 5 million people in the United States, an estimated 250,000 of whom suffer from end-stage disease.[1,2] The treatment of choice for end-stage heart failure remains cardiac transplantation. However, many patients are either ineligible for orthotopic heart transplant (OHT) due to various reasons such as age or comorbid conditions or will not receive a transplant because of limited organ availability.[2] The number of organ donations allows only approximately 2000 transplantations annually.[2,3] Spelman and Esmore[4] reported that for every 5 patients who are transplanted, 1 patient dies while on the waiting list.

Mechanical circulatory support provides a valuable therapeutic option for patients with end-stage heart failure who will not survive until a donor organ becomes available or who are not transplant candidates.[5] This support comes primarily in the form of an implantable left ventricular assist device (LVAD), which is designed to take over the work of the left ventricle. LVADs assist with providing improved blood supply that the native ventricle is unable to deliver due to heart disease. Developed in the 1960s as large mechanically complex pulsatile devices with limited mechanical durability, LVADs are now smaller continuous flow pumps capable of providing longer-term circulatory support. Since the Food and Drug Administration (FDA) approved the continuous-flow HeartMate® II for destination therapy in 2010, the number of approved LVADs implanted for lifelong support in transplant-ineligible patients has increased 10-fold.[6] According to the Interagency Registry for Mechanically Assisted Circulatory Support (INTERMACS), 10,542 patients received an LVAD for cardiac support between June 2006 and June 2013. INTERMACS is the only national registry for patients who are receiving mechanical circulatory assist device therapy to treat advanced heart failure.[7]

The LVAD consists of a percutaneous driveline that connects the implanted pump to the external components of the device. The driveline, which is also known as the percutaneous lead, contains

Abbreviations List: OHT, orthotopic heart transplant; LVAD, left ventricular assist device; FDA, Food and Drug Administration; INTERMACS, Interagency Registry for Mechanically Assister Circulatory Support; VAD, ventricular assist device; ICCU, intermediate cardiac care unit; ICU, intensive care unit; ICD-9, International Classification of Diseases, Ninth Revision, Clinical Modifications; BMI, body mass index; NIH, National Institutes of Health; REMATCH, Randomized Evaluation of Mechanical Assistance for the Treatment of Congestive Heart Failure; ISHLT, International Society of Heart and Lung Transplantation.

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electrical cables that carry the electrical current to power the pump as well as data used to provide monitoring of the device function.[8] The driveline cable is tunneled through the abdominal wall and exits through a puncture in the skin of the anterior, upper abdominal quadrant.[8] The presence of the driveline exit site places patients at risk for localized infections that can progress to involved the subcutaneous tunnel, pump pocket (if present), and systematic infections.[9]

Continuous flow pumps are associated with improved outcomes, but driveline infections continue to be a serious complication. In a retrospective study of 143 patients implanted with a HeartMate® II LVAD, Sharma and colleagues[10] found that 12% of the recipients developed a driveline infection at a median of 182 days (range 26–1138 days). Other retrospective studies found similar results, with driveline infections ranging from 14% to 19%.[9,11,12] In a prospective, multicenter study of ventricular assist device (VAD) infections conducted by Gordon and colleagues,[13] 28 of the 34 infections in their entire cohort of 150 patients experienced a driveline infection, most of which also involved other sites of infections such as pump pocket, pump housing, and bloodstream infections. The median time to first infection was 68 days, with the peak of VAD infection at 18 days. Several different VAD devices were included in this study, including 85 HeartMate® II patients which accounted for 18% of the VAD infections. The authors concluded that having a continuous flow device did not decrease the risk of infection.[13]

Despite the rapid growth in the use of LVADs, there are few recommendations or guidelines to manage the driveline exit site. To prevent infection, patients typically receive preoperative prophylactic antibiotics and meticulous care of the driveline exit site post-operatively.[5,14–27] Literature supports general care principles, including the use of aseptic technique using a sterile dressing at the exit site and the use of an antimicrobial such as chlorhexidine.[16,17,20,23–27] Literature also supports the use of a sterile occlusive dressing to completely cover the driveline exit site to prevent unwanted exposure and introduction of bacteria.[16,19] Standard practice includes frequent dressing changes if the site is moist, draining, or infected in order to keep the site clean and dry and promote healing.[14–16,23–25]

However, it remains unknown how frequently the driveline dressing should be changed in hospitalized adult patients with a newly implanted LVAD and if the frequency of the dressing change has any relationship to early onset driveline infections. There are currently scarce comparative studies that address this issue. In a survey of 38 U.S. centers, 60% of LVAD coordinators said they changed the dressing daily while only 4% changed it once a week.[28] Actual practice varies according to institutional policy, which tends to be based on experience or on clinician preference.[28]

As the use of LVADs continues to grow, it is important to evaluate the relationship between driveline dressing change and driveline infections. The aim of this study was to evaluate if LVAD driveline infection was related to the frequency of driveline dressing changes in hospitalized patients receiving a newly implanted LVAD at an academic medical center. To our knowledge, this is the first study that has compared the frequency of driveline dressing change on development of early-onset driveline infection in hospitalized adult patients with newly implanted LVADs.

Methods

Study design

Following receipt of Institutional Review Board approval, a retrospective chart review was conducted at an urban medical center that has been inserting LVADs since 2005. The center has used the HeartMate II® since 2008. Since then three surgeons have implanted the pumps and drivelines were prepared and tunneled according to surgeon preference. A list of all LVAD recipients between August 1, 2008 and September 30, 2013 was obtained from the transplant services information systems manager who keeps an accurate registry of patients undergoing LVAD therapy. The population of interest for this study was adult patients who received a HeartMate II® LVAD for the first time and were transferred out of the intensive care unit (ICU) to the intermediate cardiac care unit (ICCU) and subsequently discharged. The primary end point was driveline infection during the index admission or readmission within 30 days of discharge and frequency of driveline dressing change. The study excluded patients if they underwent LVAD implantation at an outside hospital, received an OHT during the same admission as the LVAD implant, never left the ICU, or received a pump exchange.

Driveline infection

Driveline infections were limited to local, skin and soft tissue infection at the driveline exit site. INTERMACS criteria[29] were used to identify and classify driveline infection data collected from the medical record. Criteria included presence of clinical signs and symptoms of infection (erythema, increased local temperature, pain, fever, or discharge), positive microorganism culture, abscess or deep tissue involvement, and antimicrobial therapy.[29]

Data were collected at time of LVAD implant and all readmissions within 30 days of discharge from index admission to determine reason for hospitalization. This time frame was of interest for 2 reasons. First, the CDC classifies superficial incisional surgical site infections as nosocomial if occurring within 30 days.[30] Second, the Affordable Care Act provisions provide financial incentives to hospitals to reduce 30 day readmission rates.[31] Infection-related readmissions were identified using the following International Classification of Diseases, Ninth Revision, Clinical Modifications [ICD-9] procedure codes: 996.61, 686.9, 686.8, 790.7, 682.9, 682.2, and 038.0–038.9. In addition, admission diagnoses were searched by name to verify no infection terminology was used to indicate a potential driveline infection.

Data for each patient were extracted from paper and electronic health records and included patient age, sex, race, co-morbidities, LVAD implant date, and LVAD dressing change frequency. Data were also extracted on driveline site characteristics suggestive of infection and included erythema, increased local temperature, abscess, induration, pain, and drainage. Fevers, culture results, and any treatment rendered (incision and drainage, antimicrobial therapy) were recorded.

Driveline care

Postoperatively, patients were admitted to and remained in the ICU until hemodynamically stable. While in the ICU, the frequency of driveline dressing change could occur multiple times per day depending on the presence of postoperative drainage. Once stable, patients were transferred to the ICCU where they typically remained until discharge to home or an inpatient rehabilitation facility. Once in the ICCU driveline exit site care and dressing change followed a standard written nursing procedure. It included aseptic technique, skin antisepsis using chlorhexidine, sterile occlusive dressing, use of personal protective equipment, and use of a stabilization device. The only procedural difference during this time was the frequency of the dressing change. Between August 2008 and July 2011, a daily dressing change was used; between August 2011 and October 2012, a weekly dressing change was used;