Heart, Lung and Circulation (2014) **23,** 234–241
1443-9506/04/$36.00
http://dx.doi.org/10.1016/j.hlc.2013.09.008

ORIGINAL ARTICLE

Bacteraemia in Ventricular Assist Devices: A Common Complication that Need Not Affect Clinical Outcomes

Franklin L. Rosenfeldt, MD, FRACS[a*], Lachlan J. Kwa, MBBS[a], Pramote Porapakkham, MBBS[a], Suraindra Rajadurai, MBBS[a], Kylie Jones, CCRN[a], Juliana van de Merwe, RN[a], Baki Billah, PhD[c], Pornwalee Porapakkham, MBBS[c], Donald S. Esmore, FRACS[a], Dag S. Halvorsen, MBBS[b], Victor J. Aguirre, MBBS[a], Denis W. Spelman, FRACP[b]

[a]Department of Cardiothoracic Surgery, The Alfred Hospital, Melbourne, Australia
[b]Department of Microbiology and Infectious Diseases, Alfred Hospital, Melbourne, Australia
[c]Department of Epidemiology and Preventive Medicine, Monash University, Melbourne, Australia

Received 29 January 2013; received in revised form 13 September 2013; accepted 16 September 2013; online published-ahead-of-print 18 October 2013

Background Ventricular assist device (VAD) implantation has become an effective option for patients with severe heart failure. However, device-related infections remain a significant problem. The aim of this study was to describe the incidence and microbiological aetiology of bacteraemia in patients with VADs, and to assess the impact of bacteraemia on clinical outcomes.

Methods A retrospective study was conducted of patients having VAD implantation at the Alfred Hospital (Melbourne, Australia) from October 1990 to July 2009. Medical records and microbiology databases were reviewed. Patients who were supported with a VAD for 72 h or more were evaluated for demographic data, VAD type, the occurrence of bacteraemia and clinical outcomes.

Results During the 19-year period, 135 VAD patients (89 Thoratec PVAD, 10 Novacor, and 36 Ventrassist) supported for a total duration of 17,304 (median 74) support days were included. Sixty-one patients (45%) developed VAD-associated bacteraemia, an incidence of 5.6 episodes per 1000 support days. The incidence of bacteraemia per 1000 days of support was similar for the three devices used: Thoratec PVAD, Novacor and Ventrassist VADs (7.8 ± 0.8, 5.2 ± 1.5 and 3.4 ± 0.5, respectively, $p = 0.74$). *Staphylococcus aureus* was the most common pathogen (25%). The rates of death on device, survival to transplant, recovery with explant and outcomes after transplantation, including 30-day mortality, median survival time and incidence of cerebrovascular accidents were not significantly impacted upon by bacteraemia.

Conclusions Bacteraemia is common in VAD patients. However, the incidence of VAD-associated bacteraemia is independent of device type and with aggressive antimicrobial therapy; clinical outcomes need not be affected by the bacteraemia.

Keywords Ventricular assist device • Bacteraemia • Bridge to transplantation • Destination therapy • Transplantation

*Corresponding author. Tel.: +61 3 9276 3685; fax: +61 3 9276 2317., Emails: f.rosenfeldt@alfred.org.au, rosenfeldt@bigpond.com

Introduction

Ventricular assist devices (VADs) have been developed to support patients with severe heart failure. In the past, VADs were used mainly for temporary support in end-stage heart failure until a donor organ could be found, namely "bridge to transplantation'' [1]. Recently, VADs have been used for long-term support, particularly for those who are not candidates for cardiac transplantation, namely "destination therapy'' [2]. Infection is the most common VAD-related complication especially in long-term support with a prevalence ranging from 18 to 59% [1]. Driveline infections and blood stream infections (BSI) are the most common forms [7,8]. Other VAD-related infections include infection of the device pocket [9] and infection of the pump itself [5]. In some reports, infection is associated with significant morbidity and mortality [3,4,8,11,16,21], whereas in others, outcomes are not affected [5,6]. The purpose of this study was to document the incidence and microbiological aetiology of device-related bacteraemia in a large group of patients supported with a device mainly for bridge to transplantation and to determine its effect on clinical outcomes.

Methods

All patients who underwent VAD implantation, at the Alfred Hospital (Melbourne, Australia) from October 1990 to July 2009, were evaluated. The following types of devices were used: one external device with transcutaneous connecting cannulae (Thoratec PVAD) and two implantable devices with an external driveline connecting to the internal device (Novacor and Ventrassist). Episodes of bacteraemia and of infection either in the driveline or in the pump pocket were promptly managed by early removal of intravenous catheters, surgical drainage of collections and by optimal antibiotic therapy (Table 1). No premature device explantations were performed due to infection. Optimal antibiotic therapy was determined from antibiograms of organisms cultured from blood. The medical records of each patient and the Microbiology Unit database were reviewed, and demographic and clinical information were collected. Patients who had VAD support for less than 72 h were excluded.

Table 1 Prophylaxis and Treatment of Infections.

Antibiotic prophylaxis	
1990–2002	
48 h perioperative	Cephazolin 2 g or vancomycin 1 g IV
2003–2009	
Pre-operative	Rifampacin 600 mg
Intra-operative	Vancomycin 500 mg + gentamicin 320 mg + fluconazole 200 mg
Post-operative	Fluconazole 200 mg 5 days
Wound care	
All devices	Daily dressing change with aseptic povidone iodine/chlorhexidine wash of drivelines
Ventrassist	Medihoney antibacterial gel applied to drivelines weekly Shower with driveline cover, triclosan 3% wash after shower
Antibiotic therapy	
Diagnosis of bacteraemia	Initial empirical antibiotic therapy
Culture and antibiogram	Directed antibiotic therapy
Other measures	
IV cannulae	Optimal care and early removal
Collections	Prompt surgical drainage of collections at device and drivelines

Definitions

Bacteraemia in VAD patients was defined as the isolation of a single microorganism, including fungi from one or more blood cultures taken after the operative implantation. Blood cultures were done only in the presence of clinical signs of blood stream infection and were used for diagnostic confirmation and as a tool to determine appropriate antibiotic therapy. Cultures were not done as part of a surveillance protocol. Blood culture organisms considered as possible skin contaminants such as *Coagulase negative staphylococci* were excluded. Duration of support was defined as the number of days from implantation to explantation, cardiac transplantation or death. Time to first bacteraemia was defined as the number of days between implantation and the first positive blood culture, and incidence of bacteraemia was calculated as bacteraemic episode/1000 days support. Survival with VAD was defined as a patient alive and still supported with a VAD.

Prophylactic Antibiotics

There were two perioperative antibiotic regimens used during the study period (Table 1). From 1990 to the end of 2002, the antibiotic prophylactic regimen was that most often used in all cardiac surgery at this institution: cephazolin 2 g or vancomycin 1 g intravenously for 48 h perioperatively. From 2003 to the end of the study, based on accumulating experience, the following regimen was adopted – preoperative: rifampin 600 mg orally; on induction of anaesthesia: vancomycin 500 mg infused over 1 h, gentamicin 320 mg and fluconazole 200 mg (both intravenously); postoperatively: fluconazole 200 mg daily for five days. Triclosan body washes were also used for two days preoperatively.

Techniques of Implantation

Three types of VAD were in use: Thoratec PVAD, Novacor and Ventrassist. The Thoratec PVAD device was mounted on the anterior abdominal wall and connected to the apex of left ventricle and aorta by two cannulae that traversed the anterior abdominal wall. Thus, the Thoratec did not have a pump pocket. Novacor and Ventrassist pumps were placed in a pocket in the posterior rectus sheath with an inflow cannula