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Bloodstream infections in mechanical circulatory support device recipients in the International Society of Heart and Lung Transplantation Mechanically Assisted Circulation Support Registry: Epidemiology, risk factors, and mortality

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KEYWORDS:
bloodstream infections;
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IMACS registry;
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BACKGROUND: We used multicenter international data from the International Society of Heart and Lung Transplantation Mechanically Assisted Circulation Support (IMACS) registry to determine bloodstream infection (BSI) event rate, independent risk factors, and association with mortality.

METHODS: Included were patients registered in IMACS from January 2013 through December 2015, assessed BSI event rate of mechanical circulatory support (MCS) and non–MCS-related BSIs, and conducted univariate and multivariate analyses between BSI with baseline characteristics and mortality.

RESULTS: We documented 1,606 BSIs in 1,231 of 10,171 MCS recipients (12%), with an event rate of 2.43 BSIs/100 patient-months within 3 months after implant (early onset) and 1.03 BSIs/100 patient-months after 3 months (late onset). Of these episodes, 1,378 (85.8%) were non– MCS-related BSI. Increasing body mass index and bilirubin were independent correlates of MCS-related BSI. Independent

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correlates of non–MCS-related BSI included older age, higher body mass index, previous cardiac surgery, baseline chronic renal disease and dialysis, pre-implant frailty, presence of biventricular assist device, total artificial heart or right ventricular assist device, and Interagency Registry for Mechanically Assisted Circulatory Support category 1. Survival after 3 months after implant of patients who developed early-onset BSI was 56.9% at 24 months vs 77.4% in patients without early-onset BSI ($p < 0.001$). Early-onset BSI was an independent correlate of mortality at 3 months after implantation (hazard ratio, 2.56; 95% confidence interval, 2.09-3.15; $p < 0.001$).

CONCLUSIONS: Early-onset BSI was associated with significantly increased 24-month mortality. More than 85% of these BSIs were not device related. There is an opportunity for infection prevention practices to decrease the BSI event rate, which may affect 24-month survival. These data can also serve as benchmarking for individual institutions.

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Durable mechanical circulatory support (MCS) is increasingly used worldwide as a treatment for severe heart failure as a bridge to heart transplant as well as destination therapy for patients who are not transplant candidates. In an analysis of more than 15,000 patients enrolled into the Interagency Registry for Mechanically Assisted Circulatory Support (INTERMACS), MCS-related infection or sepsis (defined as positive blood cultures or hypotension concerning for infection) occurred in up to 50% of patients at an event rate of 7.28/100 patient-months in the first 12 months of device support in the recent era of 2012 to 2014.[1] This INTERMACS report also demonstrated that device infection/sepsis had a bimodal risk ascription, with a high hazard in the first 3 months after surgery, which then declined, only to rise again after 1 to 2 years.

Bloodstream infections (BSIs), however, were not specifically recorded as a category in this registry, neither were infection sources other than the device itself. There are limited data on risk factors for and outcomes of BSI in MCS recipients. Single-center studies, mostly retrospective, note that BSIs occurred in 3.3% to 30% of patients supported with continuous-flow (CF) devices and that BSI was noted to be associated with increased mortality in these reports.[2–7] However, the risk factors, epidemiology, timing of onset, and effect of BSIs on mortality in MCS patients has not been described from a large data set. We believe that such data are vital to developing infection-prevention efforts focused specifically for MCS patients.

The specific aims of this study were to use multicenter international data from the International Society of Heart and Lung Transplantation Mechanically Assisted Circulatory Support (IMACS) registry to determine (1) the event rate of BSI, (2) the independent risk factors for BSI, and (3) the independent association between BSI and mortality.

Methods

The IMACS registry is a global registry that enrolls and monitors patients receiving durable MCS devices internationally. This registry receives data from 2 general sources: multicenter collectives and individual hospitals, with data entry through the IMACS web site. The collectives include INTERMACS, enrolling patients from the United States and Canada; European Registry for Patients with Mechanical Circulatory Support,[8] entering patients from most European centers; the UK Registry, entering patients from the United Kingdom; and the Japanese Mechanically Assisted Circulatory Support Registry,[9] enrolling patients from Japan; and individual centers entering directly into IMACS. Data are deidentified and thus the country or collective of origin cannot be identified. We obtained approval from the IMACS committee to perform research using registry data. Consent for the data collection and analysis was obtained according to the Institutional Review Board requirements of the individual centers.

We reviewed MCS patients enrolled in IMACS from January 2013 through December 2015 and abstracted data regarding baseline characteristics, type and strategy of MCS, infection, microbiology, and mortality. MCS included durable left ventricular assist devices (LVADs) with or without right ventricular assist device (RVAD) support and total artificial heart support (TAH).

Definitions

In IMACS, a positive blood culture is considered a BSI. MCS-related BSI was defined by the presence of concurrent device infection as noted in the registry. Non–MCS-related BSI was defined by the absence of concurrent device infection (i.e., device infection marked as “no” in the registry). If the blood culture result was unknown or infection location was unknown (i.e., device infection present or not), we categorized these as “missing”. We abstracted data regarding sources of BSI from the registry as well. These are categorized as catheter-related/line sepsis, urinary tract, gastrointestinal, and pulmonary, among others.

Early time period was defined as up to and including the first 3 months after device implantation, and late time period was 3 months and onwards after device implantation.

Acute care length of stay was defined as stay in the intensive care unit (ICU) after device implantation and length of stay meant days spent in the hospital after ICU stay.

Frailty was defined by the physician’s assessment of the presence of frailty in the pre-implant period. A scoring system was not used.

Outcomes

The primary outcomes of interest were BSI event rate/100 patient-months (number of BSI events divided by total follow-up time, normalized for 100 patient-months). Secondary outcomes included BSI hazard rate per month (first BSI after device implantation divided by time at risk), and mortality 3 months after implant in