Retrospective study of microorganisms associated with vascular access infections in hemodialysis patients

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Objective. The aim of this study was to assess microorganisms associated with vascular access–associated infections (VAIs) in hemodialysis patients, with respect to possible origin from the mouth.
Study Design. A retrospective and comparative analysis of the microbes associated with VAI in hemodialysis patients treated during a 10-year period was performed with the Human Oral Microbiome Database (HOMD).
Results. Of 218 patient records identified, 65 patients collectively experienced 115 VAI episodes. The most common microorganisms involved were *Staphylococcus aureus* (49.6% of infections), *Staphylococcus epidermidis* (10.4%), *Serratia marcescens* (10.4%), *Pseudomonas aeruginosa* (9.6%), and *Enterococcus faecalis/fecum* (8.7%). None of these was found in ≥1% of HOMD clone libraries, indicating that they very rarely colonize the teeth or plaque.
Conclusions. Most VAIs were associated with microorganisms more likely to originate from other body sites than from the oral cavity. The risk of a VAI being caused by microorganisms originating from the oral cavity is very small. (Oral Surg Oral Med Oral Pathol Oral Radiol 2013;115:56-61)

Renal disease is becoming increasingly recognized as a global health care crisis with a significant impact on the U.S. health care system. The U.S. has the second highest prevalence of end-stage renal disease in the world.[1] According to the U.S. Renal Data System, there were 598,311 persons with end-stage renal disease in the U.S. for the period from the fourth quarter of 2009 to the fourth quarter of 2010.[2] A large proportion of these patients receive hemodialysis. Data from the Dialysis Surveillance Network indicate that 3.2% of hemodialysis patients have a dialysis access–related infection each month.[3] Higher susceptibility to infection in this population is caused by their immunocompromised status, chronic systemic disease and illness, and repeated use of the vascular access site for hemodialysis.[3] These vascular access–related infections can lead to multiple morbidities, ranging from local infection to sepsis with multiorgan failure and death. A 10-year review of mortality rates in dialysis patients revealed that infection contributed to 24% of all deaths.[4]

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Owing to the morbidity and mortality associated with vascular access–associated infections (VAIs), the use of prophylactic antibiotics to prevent such infections is common before general surgical procedures.[5] This preventive practice has also been adopted with dental procedures. Some nephrologists or dentists prescribe prophylactic antibiotics to prevent VAIs in hemodialysis patients undergoing dental treatment. However, a systematic review by Lockhart et al. found that there is no scientific evidence linking oral microorganisms to systemic infections in renal hemodialysis patients.[6] Although some dental procedures can induce transient bacteremias,[6,7] there is no evidence that these bacteremias cause VAIs. Guidelines from the American Heart Association (AHA) indicate that antibiotic prophylaxis is not routinely recommended for dental procedures in patients with hemodialysis vascular access grafts.[8] Both publications indicated that additional research is needed on this issue. It is being increasingly recognized that such prophylactic use of antibiotics may serve minimal benefit and can result in potential significant harm. The risks of unnecessary antibiotic use include the development of resistant strains of bacteria, finan-

Statement of Clinical Relevance

These findings suggest that oral microorganisms are rarely involved in causing infections associated with vascular access in hemodialysis patients. These data support the American Heart Association recommendation that antibiotic prophylaxis is not routinely needed for dental procedures in such patients.

cial costs to the patient and/or society, and risk of adverse reactions, such as rash, gastrointestinal upset, and possibly anaphylactic shock leading to death. Thus, the rationale for antibiotic prophylaxis for various medically complex patient populations undergoing invasive dental procedures is currently being challenged.[6]

A survey of infectious disease specialists regarding the need for antimicrobial prophylaxis to prevent distant site infection revealed differing opinions. Of 477 respondents questioned specifically about prophylaxis for patients on hemodialysis with dialysis catheters or shunts, <20% reported that they "always or usually" recommended such prophylaxis before invasive dental procedures. Moreover, ~45% of the respondents indicated that they "never" recommend prophylaxis for such patients.[9] Importantly, 90% of these infectious disease specialists indicated that additional research is needed to determine indications for antibiotic prophylaxis before dental procedures in various medically complex populations.[9]

There is a pressing need for additional data on whether oral microorganisms can contribute to infections associated with vascular access in renal hemodialysis patients. In the present study, we sought to determine the potential role of oral microorganisms in causing VAIs in hemodialysis patients by identifying the microorganisms associated with such infections and determining whether they are normal inhabitants of the oral cavity.

MATERIALS AND METHODS

This retrospective record review was conducted at the University of Connecticut Health Center (UCHC). Approval for the study was received from the UCHC Institutional Review Board and from Dialysis Clinic Inc., which operates the UC Dialysis Center in Farmington. All research procedures were conducted in compliance with the Declaration of Helsinki. Electronic medical records were reviewed for all 218 patients undergoing renal hemodialysis at the UCHC Dialysis Center from January 1, 1999, to February 27, 2009. Patients on peritoneal dialysis were not included.

A VAI was defined as the occurrence of any of the following types of dialysis events, as defined by the Centers for Disease Control and Prevention (CDC)[10]:

- Local access infection: pus, redness, or swelling of the vascular access site; access-associated bacteremia not present.
- Access-associated bacteremia: blood culture positive with source identified as the vascular access site; or source unknown (i.e., absence of any other documented infection).

The following information was retrieved from the electronic medical records by a careful review of progress notes and other records: demographic data, including date of birth, sex, and ethnicity/race; medical history information; mode of vascular access (arteriovenous [AV] graft, AV fistula, catheter, or a combination); dates of VAIs; and medical status at time of VAI. In addition, reports of microbial cultures (from blood and/or vascular access sites) were reviewed to identify the specific microorganism(s) associated with these infections. Microorganisms were identified by trained microbiology laboratory personnel using standard culture techniques and biochemical analyses in the John Dempsey Hospital clinical laboratory at the UCHC.

To determine if microorganism(s) associated with VAIs could have originated from the oral cavity, the Human Oral Microbiome Database[11] (HOMD) was consulted. This is a National Institutes of Health–supported comprehensive online database listing all known bacteria found in the human oral cavity by molecular cloning techniques. VAIs associated with bacteria were classified based on whether or not the associated microorganism(s) were found in the HOMD. For VAIs associated with yeast, this classification was based on literature documenting the presence of the associated yeast in the oral cavity.[12,13]

Data were recorded in a Microsoft Excel database and analyzed with the use of descriptive statistics to assess the overall incidence of VAIs and nature of associated microorganisms. The proportions of VAIs associated with microorganisms found in the HOMD across the different vascular access types were compared with the use of an exact test because of small cell frequencies. A P value of $<.05$ was considered to be statistically significant.

RESULTS

Incidence of VAIs and subject characteristics

Of the 218 renal hemodialysis patients for whom medical records were reviewed, 65 patients (29.8%) were found to have had ≥1 episode of a VAI. There were a total of 115 VAIs across these 65 patients. Therefore, a subsample of 65 patients and 115 VAIs was used for further analyses. In the 65 patients who experienced VAIs, the mean age was 65.6 years, 66% were male (n = 43), and 34% were female (n = 22). Ethnicity/race for the 65 patients was as follows: 40 patients were white, 13 black, 9 Hispanic, 1 Asian, and 2 unknown. The most common comorbidities in these patients were diabetes mellitus (34 patients), hypertension (49 patients), and coronary artery disease (17 patients), with many patients having multiple comorbidities. Of the 115 VAIs, 50 (43.5%) occurred in patients with diabetes mellitus, 87 (75.7%) in patients with hypertension,