From March 1997 through November 1997, 8 allogenic bone marrow transplant (BMT) patients developed *Stenotrophomonas maltophilia* bacteremia on the hematology service at UCLA Medical Center (Los Angeles). Five of these patients had undergone transplantation during the same hospitalization that *S. maltophilia* bacteremia was detected (case patients). Compared with 7 concurrently hospitalized allogenic BMT patients (control patients), the 5 case patients were more likely to have been hospitalized in room A ($P = .045$), to have severe neutropenia on the culture date ($P = .028$), to have a longer duration of severe neutropenia ($P = .05$), to have severe mucositis ($P = .028$), and to have received total parenteral nutrition ($P = .028$). Pulsed-field gel electrophoresis revealed that 2 of 3 isolates from case patients hospitalized in room A were identical. In allogenic BMT patients, severe neutropenia and severe mucositis may promote infection with *S. maltophilia* by impairing host defenses.

*Stenotrophomonas maltophilia* bacteremia has been associated with patients with hematologic malignancies [1–6] and those with neutropenia [1–3, 6, 7]; however, outbreaks of *S. maltophilia* bacteremia have not been described in bone marrow transplant (BMT) patients. UCLA Medical Center (Los Angeles) is a large (661-bed) tertiary care teaching hospital with a 29-bed hematology service. In October 1997, 5 BMT patients with *S. maltophilia* bacteremia were identified on the hematology service. In addition, 2 of 3 BMT patients with *S. maltophilia* bacteremia who were identified during the prior 6 months were hospitalized in the same private room (room A) as a BMT patient in October 1997, thereby suggesting a common hospital exposure. Therefore, an investigation was undertaken to characterize risk factors for and the molecular epidemiology of *S. maltophilia* bacteremia in allogenic BMT patients.

**Methods**

Case-control studies. A case patient was defined as any BMT patient hospitalized on the hematology service at the UCLA Medical Center from 1 March 1997 through 31 October 1997 for whom *S. maltophilia* was isolated from $\geq 1$ blood cultures. To determine whether receipt of an allogenic BMT was a risk factor for *S. maltophilia* bacteremia, 8 case patients were compared with 24 control patients (3 control patients per case patient). On the day when each case patient first had *S. maltophilia* isolated from a blood culture (culture date), control patients were selected from among all BMT patients on the hematology service inpatient census by use of a random number method. Next, to determine risk factors for *S. maltophilia* bacteremia in allogenic BMT recipients, we restricted the analysis to the 5 case patients who had received an allogenic BMT during the same hospitalization that *S. maltophilia* bacteremia was detected. These 5 case patients were compared with 7 concurrently hospitalized control patients who had received an allogenic BMT earlier during the same hospitalization. For the case-control studies, common hospital exposures were ascertained for the 30-day period before the date that *S. maltophilia* was first isolated from cultures of blood specimens from case patients.

Microbiological characterization. Environmental sampling of 3 patient rooms, including room A, was performed on 30 October 1997, including the sampling of settling plates and water. All clinical and environmental isolates were identified to the species level by use of either VITEK-GNI Cards (bioMérieux Vitelk, Hazelwood, MO) or the API 20NE System (bioMérieux Vitelk). *S. maltophilia* isolates recovered from case patients and epidemiologically unrelated isolates from control patients were genotyped by pulsed-field gel electrophoresis with use of DNA digested with *SpeI* and *XhoI* and separated by means of a CHEF Mapper XA apparatus (Bio-Rad, Hercules, CA).

Statistical methods. Data were collected and analyzed by use of Epi-Info Version 6.02 (Centers for Disease Control and Prevention, Atlanta, GA). Proportions were compared by means of the $\chi^2$ or Fisher’s exact test, as appropriate. Continuous variables were compared by use of the Wilcoxon two-sample test. All $P$ values are two-tailed; $P \leq .05$ was considered statistically significant.

**Results**

Descriptive epidemiology. From 1 March 1997 to 31 October 1997, 8 allogenic BMT patients for whom blood cultures...
were positive for *S. maltophilia* met the case-patient definition. During this period, the attack rate of *S. maltophilia* bacteremia on the hematology service was 1.29 case patients per 100 admissions, compared with 0.34 case patient per 100 admissions during the prior 14 months (*P* = .029). For all case patients, *S. maltophilia* was isolated initially from blood (range, 1–9 sets of blood cultures positive per case patient) and was associated with clinical infection. Subsequently, 4 case patients (50%) had *S. maltophilia* isolated from other sites (urine, 2; respiratory tract, 1; and catheter tip, 1), and 1 case patient had relapsed bacteremia 8 months after the initial episode. Seven case patients developed primary *S. maltophilia* bacteremia after receiving an allogenic BMT (5) or cytotoxic chemotherapy (2) and were neutropenic (median neutrophil count, 50/mm³; range, 50–500/mm³) on the culture date. The eighth case patient had catheter-related bacteremia and was not neutropenic. All patients were treated with iv antibiotics; only the eighth case required catheter removal. The crude and attributable mortality rates were 25% and 12.5%, respectively.

**Analytic epidemiology.** When compared with 24 randomly selected control patients concurrently hospitalized on the hematology service, the 8 case patients were significantly more likely to have been hospitalized in the same private room (room A vs. other room: 3 of 8 vs. 0 of 24, respectively; OR, undefined; *P* = .011). They were also more likely to have received an allogenic BMT during the same hospitalization (5 of 8 vs. 3 of 24, respectively; OR, 11.67; *P* = .011) and to have had a longer duration of hospitalization from admission to the culture date (median, 19 vs. 8 days, respectively; *P* = .038). There were no significant differences between case and control patients with respect to the other characteristics examined.

Compared with 7 concurrently hospitalized control patients, the 5 case patients were more likely to be hospitalized in room A (*P* = .045), to have severe neutropenia (neutrophil count, <50/mm³) on the culture date (*P* = .028), to have a longer duration of severe neutropenia (median, 9 vs. 4 days, respectively; *P* = .05), to have a physician diagnosis of severe mucositis (*P* = .028), and to have received total parenteral nutrition (*P* = .028) in the 30 days before the culture date. Although not a significant finding, case patients tended to be more likely than control patients to have received imipenem therapy before the culture date (4 of 5 vs. 3 of 7; OR, 5.3; *P* = .29). Also, of patients receiving this antibiotic, case patients received an average of 6 more days of imipenem than did control patients (median, 15 vs. 9 days, respectively; *P* = .28). Case and control patients did not differ significantly in terms of any other risk factor examined, including BMT conditioning regimen, HLA matching, graft versus host disease, or receipt of prophylactic or therapeutic antimicrobials.

**Procedure review and control measures.** All patient rooms were private, and in-room HEPA filtration units were used for all BMT patients. The 3 cases exposed to room A had been hospitalized therein during March, June, and October 1997.

After the outbreak was recognized, room A was closed to patient admissions on 15 October 1997; it was reopened on 4 November 1997, when *S. maltophilia* was not detected in any of the environmental cultures.

Imipenem was used for the empirical treatment of febrile neutropenia on the hematology service until November 1997, when the combination of piperacillin/tazobactam and ceftazidime was substituted as treatment. In June 1998, imipenem use was resumed for the empirical treatment of neutropenic fever when only 1 new case and 1 recurrent case of *S. maltophilia* bacteremia were detected in the preceding 8 months. From June 1998 through August 1999, only 2 additional cases of *S. maltophilia* bacteremia occurred on the hematology service.

**Microbiology.** Five pulsed-field gel electrophoresis strain types were observed among 10 *S. maltophilia* isolates from 8 case patients (figure 1). *S. maltophilia* strains from 2 case patients with exposure to room A had an identical banding pattern. The *S. maltophilia* strain isolated from the third case patient with exposure to room A was unrelated to these 2 strains but was identical to that isolated from another case patient. The latter 2 case patients had been hospitalized in room B during admissions 3 months apart (July 1997 and October 1997) but had had no direct contact.

**Discussion**

In this investigation, recent receipt of an allogenic BMT was a significant risk factor for *S. maltophilia* bacteremia, developing in 5 (24%) of 21 such patients during the study period. In allogenic BMT patients, *S. maltophilia* bacteremia was correlated with treatment-associated toxicity, including more severe, prolonged neutropenia, and severe mucositis and its correlate, receipt of total parenteral nutrition. Although concurrent neutropenia was present in 21%–86% of previously described patients with hematologic malignancies who had *S. maltophilia* infection [1–3, 6, 7], it was not identified as a risk factor in 2 previous case-control studies [4, 8].

Although *S. maltophilia* bacteremia has been associated with tunneled central venous catheters [1–6], we found only 1 BMT patient with local catheter-related infection, and 5 BMT patients were successfully treated without catheter removal. Instead, our findings suggest that severe mucositis may predispose BMT patients to develop *S. maltophilia* bacteremia through altered gastrointestinal mucosal barriers. Profound impairment of host immune defenses in the preengraftment period, including severe, prolonged neutropenia, as well as the selective effect of antimicrobials, may further increase the risk of bacteremia associated with altered mucosal barriers.

*S. maltophilia* is intrinsically resistant to imipenem, and treatment with this antimicrobial has been associated with *S. maltophilia* infection in some [1, 4] but not in other studies [3, 5–9] where examined. In our study, case and control patients did not differ significantly with respect to the type or duration of...
The hospital environment may have been the reservoir for S. maltophilia in some of the cases was suggested by the strong statistical association with exposure to a single patient room (room A) and the finding that an identical S. maltophilia strain was isolated from blood specimens from 2 of the 3 case patients hospitalized in room A over an 8-month period. However, stool surveillance cultures were not performed for patients during the study period. Further studies are needed to better define environmental reservoirs for S. maltophilia, the prevalence of gastrointestinal colonization among BMT patients developing invasive infection, and the impact of the selective effect of antimicrobials.

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References