Lactobacillus Bacteremia: Description of the Clinical Course in Adult Patients Without Endocarditis

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Lactobacillus bacteremia in the absence of endocarditis is a rare entity, and the clinical relevance of such bacteremia remains unclear. The clinical courses of lactobacillus bacteremia without endocarditis in 43 previously described patients and 12 new patients were reviewed. Bacteremia with Lactobacillus alone occurred in 34 (62%) of the patients, and 12 (22%) of the patients had bacteremia with other organisms, including Lactobacillus. Lactobacillus was isolated from another site in 18 (33%) of these patients. Intravenous catheter infections were not noted in these patients. Underlying conditions included cancer (6 patients), organ transplantation (9), diabetes mellitus (4), and recent surgery (12). Fever occurred in all patients, and eight (15%) of the patients experienced a sepsis syndrome. The mortality rate was 14%; however, only three deaths were attributed solely to lactobacillus sepsis. Lactobacillus bacteremia is an uncommon condition that usually occurs in patients with severe underlying illnesses and is frequently seen as a part of a polymicrobial infection. Blood cultures positive for Lactobacillus represent true infection and not contamination. Although resistance to commonly used antibiotics is common, the mortality rate associated with this bacteremia appears to be low.

Lactobacillus species are ubiquitous microorganisms colonizing the mucosal surfaces of the mouth, gastrointestinal tract, and genitourinary tract. This bacterium has been reported infrequently as a cause of serious infections in either immunocompetent or immunocompromised hosts [1–3]. Subacute bacterial endocarditis is the most commonly reported clinical infection [2, 3]. The characteristics of lactobacillus bacteremia in the absence of endocarditis have been less well defined. Sepsis syndromes caused by Lactobacillus can be seen, and Lactobacillus species that are resistant or tolerant to vancomycin as well as to the commonly used newer cephalosporins and fluoroquinolones have been reported [2–5].

In this review, we define the characteristics of lactobacillus bacteremia without underlying or suspected endocarditis and analyze the clinical features, laboratory values, and clinical outcomes of 12 new and 43 previously reported cases of lactobacillus bacteremia in adults without endocarditis. In addition, four selected cases are reported to highlight the various clinical settings in which this infection can occur.

Materials and Methods

Cases were identified by reviewing the reports of blood cultures positive for Lactobacillus over a 12-year period (1984–1996) from the microbiology records of the Vanderbilt University Medical Center and St. Thomas Hospital, Nashville, Tennessee (table 1). Patients without suspected or documented endocarditis for whom two or more blood cultures were positive for Lactobacillus or for whom the organism was isolated from blood and another site of clinical infection qualified for inclusion in the study. The clinical record of each of these patients was then reviewed.

On the basis of the microscopic appearance, colony morphology, catalase reaction, growth on selective lactobacillus agar, and results of gas chromatography [5], genus and species identification was made by the Tennessee Department of Public Health Reference Laboratory. In five of the 12 cases from our institutions, susceptibility testing by broth microdilution methods was also performed by this laboratory.

A MEDLINE search of the medical literature from 1973 to 1996 was performed, and 43 additional patients with lactobacillusemia without endocarditis were identified; their cases were analyzed for clinical features, source of positive cultures, antibiotic therapy, and outcomes (table 2).

Results

Fifty-five patients with lactobacillus bacteremia without endocarditis were identified, including 12 patients from our centers and 43 patients whose cases were previously reported in the literature. There were 27 males and 24 females; the gender of four patients was not reported. The average age of the patients was 57.4 years. For these patients for whom data were available, the average duration of hospitalization was 11.6 days, while the average duration of antibiotic treatment was 12.1 days. Forty-one patients (75%) received a variety of antimicrobial regimens (tables 1 and 2). Four patients received no anti-
Table 1. Summary of data on 12 previously unreported cases of lactobacillemia.

<table>
<thead>
<tr>
<th>Case no., age (y)/ sex</th>
<th>Underlying condition(s)</th>
<th>Clinical presentation</th>
<th>Other positive cultures (organism[s])</th>
<th>Antibiotic therapy (duration in d)</th>
<th>Survival</th>
</tr>
</thead>
<tbody>
<tr>
<td>1, 54/M</td>
<td>Acute leukemia</td>
<td>Pancytopenia, fever, hypotension</td>
<td>None</td>
<td>Gentamicin (21)</td>
<td>Yes</td>
</tr>
<tr>
<td>2, 72/F</td>
<td>Coronary artery disease</td>
<td>Chest pain, fever, hypotension, multiple caries</td>
<td>None</td>
<td>Cefazolin (21)</td>
<td>No</td>
</tr>
<tr>
<td>3, 60/M</td>
<td>Acute myocardial infarction, hypertension</td>
<td>Fever, interstitial infiltrates</td>
<td>None</td>
<td>None</td>
<td>Yes</td>
</tr>
<tr>
<td>4, 80/F</td>
<td>COPD, diabetes mellitus, renal failure</td>
<td>Fever, pleuritic pain, carious teeth, right infiltrate, hypotension</td>
<td>None</td>
<td>Vancomycin (3)</td>
<td>Yes</td>
</tr>
<tr>
<td>5, 57/F</td>
<td>Heart transplant</td>
<td>Fever, productive cough, malaise, diarrhea</td>
<td>None</td>
<td>Vancomycin (9), erythromycin (9), ceftazidime (9)</td>
<td>Yes</td>
</tr>
<tr>
<td>6, 89/F</td>
<td>Stroke, dementia</td>
<td>Fever, urosepsis</td>
<td>None</td>
<td>Ceftriaxone (9), ciprofloxacin (9)</td>
<td>Yes</td>
</tr>
<tr>
<td>7, 74/M</td>
<td>Coronary bypass graft, hypertension</td>
<td>Fever, sepsis, pneumonia, hypertension</td>
<td>Blood (Pseudomonas aeruginosa, Candida albicans)</td>
<td>Vancomycin (21), ceftazidime (21), metronidazole (14)</td>
<td>Yes</td>
</tr>
<tr>
<td>8, 90/F</td>
<td>Hypertension, osteoarthritis</td>
<td>Fever, urosepsis, hypotension</td>
<td>None</td>
<td>Imipenem (2), ciprofloxacin (5)</td>
<td>Yes</td>
</tr>
<tr>
<td>9, 78/F</td>
<td>Diabetes mellitus, Bell's palsy</td>
<td>Congestive heart failure, atrial fibrillation, fever</td>
<td>Blood (viridans streptococcus)</td>
<td>Arpcillin/sulbactam (2), ciprofloxacin (5)</td>
<td>Yes</td>
</tr>
<tr>
<td>10, 67/F</td>
<td>Hypertension, diabetes mellitus</td>
<td>Fever, urosepsis</td>
<td>None</td>
<td>TMP-SMZ (10)</td>
<td>Yes</td>
</tr>
<tr>
<td>11, 63/M</td>
<td>Hypertension</td>
<td>Fever, pneumonia</td>
<td>None</td>
<td>Gentamicin (7), vancomycin</td>
<td>No</td>
</tr>
<tr>
<td>12, 52/M</td>
<td>Umbilical hernia</td>
<td>Fever, vomiting</td>
<td>Stomach specimen (Lactobacillus), biopsy specimen</td>
<td>None</td>
<td>No</td>
</tr>
</tbody>
</table>

NOTE. COPD = chronic obstructive pulmonary disease; TMP-SMZ = trimethoprim-sulfamethoxazole.

biotic therapy, and two of these patients survived despite lactobacillemia. Both these patients were normal hosts.

Twenty-five patients (45%) had an immunocompromising condition (transplantation, diabetes mellitus, or cancer), and 12 patients (22%) had undergone recent surgery. Remarkably, there were no patients with documented central catheter infections with Lactobacillus. More than one microorganism was isolated from blood specimens from 12 patients (22%). These microorganisms included enterococci (6 patients), Pseudomonas aeruginosa (1), Candida albicans (1), viridans streptococcus (1), coagulase-negative staphylococcus (3), Candida krusei (1), and Torulopsis glabrata (1). Of these 12 patients, seven were liver transplant recipients with coexisting bloodstream infections due to enterococci or streptococci (1).

Fever occurred in almost all patients. Other underlying conditions included carious teeth (4 patients), urinary tract infection (6), and vascular graft (3) (tables 1 and 2). There were eight deaths (14%), but it was possible to attribute the death to lactobacillemia sepsis in only three of these patients (table 1, patient 11; table 2, two patients [7]). Eight patients (15%) had hypotension and fever in association with lactobacillemia, thus suggesting a sepsislike syndrome. However, it was difficult to determine the severity of the infection in many of the other patients because of incomplete clinical documentation.

Patients who survived or died did not differ in terms of mean age (57 vs. 59 years, respectively), gender, frequency of surgery or immunosuppressive conditions, or occurrence of infection with other microorganisms. Lactobacillus was isolated from another site in 18 patients (33%). All eight of the patients from the Mayo Clinic [1] were liver transplant patients for whom Lactobacillus was isolated from bile, liver abscesses, or both. Other sites from which Lactobacillus was isolated were highly variable and included lymph nodes, dental abscesses, peritoneum, stomach, and lochia in association with clinical endometritis.

Isolated lactobacillemia occurred in 34 patients (62%), but another possible site of clinical infection was present in 18 (53%) of these patients. These sites included the urinary tract (4 patients), gastrointestinal tract (2), endometrium (3), peritoneal cavity (2), carious teeth (2), lung (4), and splenic abscess (1). Five other patients had sepsis when they were neutropenic, and the presumed source of the microorganisms was the gut. Lactobacillus was isolated from the blood a median of 3 days (range, 2–6 days) after specimens for cultures were drawn from all the patients from our institutions. The time of isolation of Lactobacillus could not be determined from the cases reported in the literature.

In five of 12 cases from our institutions, susceptibilities were determined by broth microdilution techniques; the isolates were noted to be uniformly resistant to vancomycin, susceptible to erythromycin, and variably susceptible to cephalosporins, penicillins, and quinolones. In the remaining 43 cases, 28 (65%)
Table 2. Summary of data on 43 previously reported cases of lactobacillemia.

<table>
<thead>
<tr>
<th>[Reference] year</th>
<th>No. of cases</th>
<th>Clinical presentations (no. of patients)</th>
<th>Other sites positive for Lactobacillus (no. of patients)</th>
<th>Antibiotic therapy (no. of patients)</th>
<th>No. of surviving patients/total no.</th>
</tr>
</thead>
<tbody>
<tr>
<td>[6] 1973</td>
<td>3</td>
<td>Erysipeloid (1); tooth abscess, hypotension (1); adenocarcinoma of stomach (1)</td>
<td>Lymph node (1)</td>
<td>None (1); Pen, Gm (1); Gm (1)</td>
<td>3/3</td>
</tr>
<tr>
<td>[7] 1978</td>
<td>3</td>
<td>Colitis, hypotension (1); peritonitis, hypotension (1); postoperative fever (1)</td>
<td>None (3)</td>
<td>Gm (1); Chl (1); Pen (1); Amp/Subl (3); Cpx (2); Gm (2); Tet (1)</td>
<td>1/3</td>
</tr>
<tr>
<td>[2] 1978</td>
<td>6</td>
<td>Endometritis (2); periomphalitis (1); dental abscess (1); peritonitis (2)</td>
<td>Lochia (1); umbilical cord (1); dental abscess (1); peritoneal fluid (1)</td>
<td></td>
<td>6/6</td>
</tr>
<tr>
<td>[4] 1982</td>
<td>1</td>
<td>Pyonephrolithiasis (1)</td>
<td>Urine (1)</td>
<td>Gm, Amp/Subl (1)</td>
<td>1/1</td>
</tr>
<tr>
<td>[8] 1985</td>
<td>1</td>
<td>Pyelonephritis (1)</td>
<td>Urine (1)</td>
<td>Em (1)</td>
<td>1/1</td>
</tr>
<tr>
<td>[9] 1987</td>
<td>1</td>
<td>Splenic abscess, osteomyelitis of thumb (1)</td>
<td>None (1)</td>
<td>Cpx, Gm (1)</td>
<td>1/1</td>
</tr>
<tr>
<td>[10] 1988</td>
<td>2</td>
<td>Delirium (1); atrioventricular graft infection (1)</td>
<td>Graft (1)</td>
<td>None (1); Amp/Gm (1)</td>
<td>1/2</td>
</tr>
<tr>
<td>[14] 1995</td>
<td>3</td>
<td>AIDS, fever, headaches (1); AIDS, fever, diarrhea, fungemia (1); AIDS, fever, candidal esophagitis, Kaposi's sarcoma (1)</td>
<td>None (3)</td>
<td>Vm, Cm (1); Vm, AmB (1); Vm, Cm, Cfa (1)</td>
<td>3/3</td>
</tr>
<tr>
<td>[15] 1996</td>
<td>8</td>
<td>Aortic graft infection (2); liver cancer (1); unknown (1); fever of unknown origin, urinary tract infection (1); renal transplant, respiratory tract infection (1); salpingitis (1); liver transplant, pneumonia (1)</td>
<td>None (8)</td>
<td>Unknown (8)</td>
<td>8/8</td>
</tr>
<tr>
<td>[11] 1991</td>
<td>1</td>
<td>Endometritis (1)</td>
<td>None (1)</td>
<td>Czid, Vnr (1)</td>
<td>1/1</td>
</tr>
<tr>
<td>[5] 1991</td>
<td>3</td>
<td>Neutropenic fever, cancer (3)</td>
<td>None (3)</td>
<td>Imi (1); Em (3)</td>
<td>3/3</td>
</tr>
<tr>
<td>[12] 1992</td>
<td>1</td>
<td>Endometritis (1)</td>
<td>None (1)</td>
<td>Unknown (1)</td>
<td>1/1</td>
</tr>
<tr>
<td>[13] 1993</td>
<td>2</td>
<td>Uterine fibroids (2)</td>
<td>Amniotic fluid (2)</td>
<td>Unknown (2)</td>
<td>2/2</td>
</tr>
<tr>
<td>[1] 1994</td>
<td>8</td>
<td>Hepatic abscess (5); cholangitis (1); biliary fistula (1); hepatic necrosis (1)</td>
<td>Bile (6); abscess (5)</td>
<td>Vm, Atm, Mz (1); Vm, Am, Czid (1); Vm, Am, Czid, Gm, Mz (1); Vm, Atm, Ctri (1); Vm, Atm, Cm, Cfp (1); Vm, Cm, Gm, Mz (1); Vm, Gm (1); Vm, Atm, Ctri, Pen (1); Vm, Pen, Pen, Mz (1)</td>
<td>6/8</td>
</tr>
</tbody>
</table>

NOTE. AmB = amphotericin B; Amp = ampicillin; Atm = aztreonam; Cfa = ceftazolin; Chl = chloramphenicol; Cm = clindamycin; Cpx = ciprofloxacin; Ctri = ceftriaxone; Czid = ceftazidime; Em = erythromycin; Gm = gentamicin; Imi = imipenem; Mz = metronidazole; Pen = penicillin; Sub = sulbactam; Tet = tetracycline; Vm = vancomycin.

had susceptibility studies performed; 21 (75%) of these patients received appropriate antimicrobial therapy, and the remaining seven (25%) received inappropriate antimicrobial therapy.

Selected Case Reports

Case 1

A 54-year-old man with a 4-week history of fatigue, weakness, shortness of breath, and easy bruising was admitted to the hospital for evaluation. Acute myelogenous leukemia was diagnosed, and chemotherapy was initiated. Ten days later, a temperature of 102.2°F developed. Three sets of blood cultures yielded Lactobacillus species. Urine cultures and repeated chest radiographs were unremarkable. A surface echocardiogram revealed no vegetations. CTs of the abdomen and chest were negative for abscesses or tumor.

The patient was empirically treated with piperacillin, ceftazidime, and ciprofloxacin. Vancomycin, fluconazole, and
acyclovir were subsequently added to the therapeutic regimen because of persistent fever. Despite these antibiotics, hypotension, mental confusion, and gastrointestinal bleeding developed. The antibiotic therapy was changed to gentamicin, erythromycin, and imipenem when results of susceptibility tests became available. The isolate was noted to be susceptible to gentamicin, clindamycin, and erythromycin and resistant to vancomycin, cefazolin, and penicillin.

The patient became afebrile 4 days after the change in antibiotics. The neutropenia resolved soon afterward. Repeated blood cultures were negative. He was subsequently discharged to home.

Comment. This was a neutropenic patient who had sepsis syndrome with a vancomycin-resistant *Lactobacillus*. Gut flora was the presumed source of sepsis. There was no evidence of bacterial endocarditis.

**Case 2**

A 72-year-old woman with a history of coronary artery disease was admitted to the hospital for evaluation of chest pain and a low grade fever. Physical examination revealed an ill-appearing woman with a temperature of 100.2°F, a blood pressure of 92/70 mm Hg, and a pulse rate of 102. The only other findings were coarse crackles in the lung fields and poor dentition with multiple caries. Laboratory studies revealed a WBC count of 6,200/mm³, a hematocrit of 31%, and a platelet count of 252,000/mm³. A chest radiograph revealed bilateral interstitial changes consistent with congestive heart failure. A surface echocardiogram showed a reduced ejection fraction but no valvular vegetations. Two sets of blood cultures yielded *Lactobacillus* species.

Despite aggressive treatment with diuretics, pressor agents, antiarrhythmic agents, and empirical cefazolin and metronidazole, her condition continued to deteriorate with persistent hypotension and fever. She died 10 days after admission. Testing of the sensitivity of *Lactobacillus* species to antibiotics was not done because the organism was thought to be a contaminant.

Comment. This was a febrile immunocompetent patient with lactobacillus sepsis syndrome; there was no other infection explaining the cause of her death.

**Case 3**

A 60-year-old man was admitted to the hospital with an acute myocardial infarction. His medical history was significant for heart failure, hypertension, and gout. Physical examination revealed an acutely ill man with a temperature of 101.3°F, a blood pressure of 128/78 mm Hg, and a pulse rate of 104. He had coarse crackles over both lung fields. Two days after hospitalization, the patient’s temperature rose to 102.3°F, and sputum, urine, and blood were obtained for culture. Both sets of cultures of blood obtained 1 day after the development of fever yielded *Lactobacillus* species. The isolate was susceptible to erythromycin and clindamycin and resistant to trimethoprim-sulfamethoxazole, tetracycline, penicillin, vancomycin, and ciprofloxacin.

Chest radiographs revealed bilateral interstitial infiltrates. Urine and sputum cultures were negative. Although antibiotic therapy was not started, he became afebrile over 4–5 days. A surface echocardiogram was negative for vegetation but revealed mild impairment of diastolic function.

Comment. This was an immunocompetent patient with mild congestive heart failure and lactobacillemia who did not have evidence of sepsis syndrome. The isolate was not thought to be a contaminant because two separate sets of blood cultures were positive; however, this isolate lacked virulence in this host.

**Case 4**

An 80-year-old woman was admitted to the hospital because of a 5-day history of fever, productive cough, and right-sided pleuritic chest pain. Her medical history was significant for chronic obstructive airway disease, diabetes mellitus, and chronic renal failure. The patient had a temperature of 101.3°F, a blood pressure of 98/78 mm Hg, and a pulse rate of 108. She had poor dental hygiene with multiple carious teeth and scattered crackles and a soft pleural rub over the right lower base of the lung. A chest radiograph revealed a right lower lobe infiltrate. Sputum and urine cultures were negative. Two sets of blood cultures yielded *Lactobacillus* species.

The patient was treated with empirical vancomycin for 3 days, followed by a 9-day course of ampicillin/sulbactam. After 3–4 days of persistently high temperatures and hypotension, her condition improved clinically, and she was discharged 12 days after admission. After the patient was discharged, the isolate was reported to be susceptible to erythromycin, tetracycline, ampicillin, and gentamicin and resistant to vancomycin and cefazolin.

Comment. This patient had multiple underlying illnesses and possible lactobacillus sepsis. Her condition improved clinically when her therapy was switched to ampicillin/sulbactam. There was no clinical evidence of endocarditis. The source of *Lactobacillus* may have been the teeth.

**Discussion**

*Lactobacillus* species are commensals of human mucosal tissues (including the oropharynx, vagina, and gut) but are not part of the skin flora. They are microaerophilic, gram-positive rods that are not motile and do not form spores. They ferment glucose but do not produce catalase or oxidase. Gas chromatography reveals the characteristic single peak of lactic acid that lactobacilli produce, hence their name. Microscopy shows that their morphology resembles members of other genera, including *Corynebacterium*, *Clostridium*, *Nocardia*, and *Streptococcus*. Lack of motility and catalase negativity distinguish lacto-
bacilli from *Listeria*, and a negative hydrogen sulfide reaction distinguishes them from *Erysipelothrix*.

*Lactobacillus* species have been reported as a cause of subacute endocarditis in > 41 patients [16]. Lactobacillemia has also been associated with other comorbid conditions such as pneumonolitiasis [4], neutropenia following chemotherapy for cancer [5, 10, 11], endometritis following dilation and curettage [12], aortic graft infection [9], and abscesses [6, 17]. More rarely, lactobacillus bacteremia has been reported as a complication of puerperal infections, such as endometritis or amniotitis [2, 17, 18], and in association with AIDS [14].

The patients described in this report are unique in that they represent a series of patients with lactobacillus bacteremia in the absence of endocarditis. The clinical syndromes in these patients ranged from an asymptomatic presentation to sepsis syndrome. Multiple portals of entry were implicated in these infections, including the oropharynx, the genitourinary tract, and the gastrointestinal tract. The criteria used to define lactobacillus bacteremia — i.e., two sets of blood cultures positive for *Lactobacillus* or isolation of the organism from the blood and another site of clinical infection — suggest the presence of actual infection rather than contamination of blood cultures from skin flora or transient mucosal tissue-based bacteremia. The fact that *Lactobacillus* is not part of the skin flora and the fact that this organism has not been documented to cause intravascular catheter-associated infections also support true infection. In addition, Weinstein et al. [18] did not find *Lactobacillus* to be a contaminant in their series of 500 cases with positive blood cultures.

Risk factors for the development of lactobacilllemia appear to include persistent neutropenia, the use of broad-spectrum antibiotics resulting in the persistence of resistant gastrointestinal flora; other immunosuppressive conditions [3]; selective bowel decontamination, which some liver transplant recipients undergo; and the use of invasive gastrointestinal or respiratory procedures [1, 19]. In addition, abdominal surgical procedures, such as placement of a Roux-en-Y loop, may play a role by altering the bowel flora, resulting in subsequent lactobacillus infection [1, 20].

Infections caused by *Lactobacillus* may be underrepresented in the medical literature because of the failure to recognize this gram-positive rod as a pathogen, as was seen in two of our cases in which there was no treatment despite blood cultures positive for *Lactobacillus* species (patients 3 and 12). In addition, failure to perform susceptibility tests may lead to inadequate treatment of these patients. However, the relatively low overall mortality rate suggests low virulence of the organism.

Treatment of lactobacilllemia should be guided by the clinical presentation and results of susceptibility testing because of the unusual antimicrobial susceptibility pattern associated with this organism [1, 2, 21]. Several investigators [16, 21, 22] have reported vancomycin resistance with MICs of > 256 μg/mL. The frequent use of vancomycin therapy for patients in intensive care units and neutropenic patients may account for the pathogenic characteristic of this organism in these patient populations.

Much of the early literature supported the use of a combination of penicillin or other β-lactam agent and an aminoglycoside in the treatment of lactobacilllemia, especially when deep-seated infection was suspected [2, 7, 21]. Bayer and colleagues [21] noted that the MICs of penicillin, ampicillin, and cephalothin for nine isolates were within achievable serum levels of these drugs; however, only 52% of the MBCs of these three antimicrobials were within the range of achievable serum levels. Two of the nine isolates were highly resistant to vancomycin (MICs, > 160 μg/mL), whereas the MBCs of vancomycin for seven of the nine isolates were > 160 μg/mL. Eight of the nine isolates were inhibited by clindamycin, but none were killed.

Bayer et al. [21] also demonstrated synergistic activity of penicillin and ampicillin with either streptomycin or gentamicin, but no synergy was noted between vancomycin and aminoglycosides. Of the parental cephalosporins, cephaloridine, cefazolin, and cefamandole were the most active inhibitory and bactericidal agents. Cefoxitin and cephalothin were not bactericidal at clinically attainable levels. These studies also demonstrated that lactobacilli were generally resistant to metronidazole.

In the United Kingdom, Maskell and Pead [23] noted that 91 urine isolates of lactobacill were almost uniformly resistant to both norfloxacin and ciprofloxacin. Further susceptibility studies of lactobacill [13, 19, 24, 25] have shown the following: the organisms were uniformly resistant to trimethoprim-sulfamethoxazole; the third-generation cephalosporins varied in their effectiveness against the isolates; the quinolones had poor activity, but clindamycin, gentamicin, tobramycin, and chloramphenicol were almost 100% effective. These studies also showed that the MIC<sub>90</sub> of penicillin and the MIC<sub>90</sub> of ampicillin were in the range of 1–2 μg/mL. Thus, large intravenous doses of penicillin would be necessary to efficiently inhibit *Lactobacillus*. The MICs of imipenem and erythromycin are low; these agents have been used to successfully treat three patients with lactobacillus bacteremia and may prove to be a useful therapeutic alternative for patients with penicillin allergy, although further studies are indicated to confirm these data [5].

Given the unusual and variable sensitivities reported in the literature, it is obvious that sensitivity testing is of utmost clinical importance. The mechanism of vancomycin resistance in lactobacill is uncertain; it may involve diminished binding of the antibiotic to the cell as a result of altered peptide sequences, or the activity of vancomycin may be reduced because of exclusion of the antibiotic from its target sites by the target cell wall [20].

The actual mortality rate associated with lactobacillus sepsis appears to be low; some patients have survived without therapy or with therapy that would unlikely be active against these pathogens. One should consider *Lactobacillus* as a possible
pathogen in patients with bacteremia due to gram-positive rods whose conditions are not improving with vancomycin therapy. In this situation, adding an antimicrobial likely to be active against *Lactobacillus* could be appropriate until results of identification and susceptibility tests are available. Some cases described here may represent transient, self-contained bacteremia, but some of the deaths also appear to be related to lactobacil-


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